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SOCIAL LIFE AMONG OUR ABORIGINES.

BY W. H. DALL.

"One touch of nature shows the whole world kin."

THE materials and the man have not yet come together which are to result in any picture of the social life of the American Indians or Eskimo equal in fidelity to that which is printed of our own social life on the pages of the ordinary "society" novel. At least this is one of the reasons why nothing has ever been published which exhibits to the civilized reader the play of sentiment and passion, fear, hope, aspiration and reverence which actuate the red or the brown man as much, if in different mode, as they do his paler cotemporary. It is true we have the novel of the Cooper class, in which a red man, evolved from the inner consciousness of the author, is impregnated with the ideas and sentiments of a Chateaubriand. This has, however, become antiquated, even with the philanthropist, and seldom furnishes texts for missionary meetings in these days. We have numerous graphic accounts of the manners and customs of the Indian tribes as regarded from the white standpoint, but these are wholly defective in the region of greatest interest, that of the native mental atmosphere. There are speeches, still to be found in school readers, in which Indian chiefs apostrophize the "Great Father" in language well chosen and eloquent, dignified by its simplicity and directness, and only unsatisfactory from the absence of any means of knowing how much of the reporter or interpreter is combined with the original.

It is hardly to be expected, perhaps, that the "squaw-man" of the west or the keen-witted trader of the north would realize the

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value to the world of a faithful picture of the life which he (more than any other man) is better situated to observe; even if he were competent to delineate it. Where shall be found a Becker who will give us an Indian "Charicles"?

Another and most serious difficulty lies in the way. In the life of the average native, especially in the far north, there is little but a struggle for existence with a niggardly environment. Their festivals are few and consist chiefly of eating and violent motions, termed dancing for want of a better and more characteristic word, or in donations where the host is the giver. Their shamanistic performances, full of excitement and interest, still have little to satisfy the love of enjoyment latent in every human being. Having no theatres, no books, no *improvisatores*, no means more rational than the above-mentioned examples for exciting pleasurable sensations, there is no reason for wonder when we find in the savage mind the physical relations of sex, representing to him nearly all that civilization finds in art, literature or philanthropy. Ideas connected with these relations as his sole source of unalloyed pleasure, permeate all his social relations, his wit, his motives, his tales, traditions, animistic faith and desires.

Hence, not only would the faithful relation of the mental phases of his life be unsuited to modern taste and modesty, but the mode of action of other sentiments in his mind and social relations, not in themselves offensive, is so intermingled with the first mentioned as to render the representation of them, if dissected separately, in most cases only a mangled caricature of savage thought.

To the same absence of means for rational pleasure may be ascribed the fatal predilection for drunkenness and gambling universal among savages and reappearing among the very poor in the slums of great cities.

Dr. Rink, in his "Tales and Traditions of the Eskimo," has come nearer than any one else toward occupying part of the vacant field by a judicious expunging of the erotic element in the folk-lore he relates.

The personal experience of the author during several years in Northwestern Alaska gave him now and then a glimpse of the social thought of the Eskimo and Indians by whom he was surrounded, and from these reminiscences may be gleaned a few items which, without trespassing on the realm of Cooperian fiction, may give a slight insight into the working of the human mind under savage conditions. But it must be recollected that

any view of native characteristics which leaves out the erotic element, resembles a vine from which the trellis has been removed.

The Eskimo of Norton Sound, Alaska, resemble most of the northern savage peoples in a total absence of reticence on all subjects, except before strangers. After friendship is assured, a matter often a long time postponed after first acquaintance, conversation may be freely indulged in on any subject relating to the individual unless it be the shamanic mysteries or superstitions. In this way I learned that even Eskimo life has its touches of romance. A middle aged woman, employed as a seamstress by our party, told me the story of her life.

Born at Shaktolik, her wanderings had been confined between the Indian territory inland, the Yukon mouth on the south, and the Polar Ocean. When of marriageable age her parents, being old and desiring to settle their daughter in life, took her with them to the Kaviiak country. They had heard of an old man there, very wealthy, according to their ideas, in deerskin dresses and supplies of food, and who, in addition to the two he had already, wished to acquire another wife to be the youthful pet of his old age. They arrived at his house in the depth of winter, were hospitably received, and opened negotiations. The wayward girl, moved by the contemptuous glances of the elder wives, the absence of eye-lashes and presence of sundry wrinkles in her proposed partner, or by the fact that she would be wholly separated from her own people, fled in the night with a passing party of dog-sledges and natives, leaving her chagrined parents to settle as they might with the Kaviiak sage.

At Shaktolik she knew a young Eskimo, tall, handsome, a good hunter, and unmarried. Friendly glances passed between them; in short, she loved him and hoped to be his wife. To adorn his deerskin garments, to applaud him at the winter dances, to proudly receive the sinew and belly of the deer, wife's perquisites, when, on his return from hunting, she met him with the smoking dishes of seal meat and fish she knew so well how to prepare—these privileges she lovingly and proudly anticipated. Alas! "his face was very good but his heart was very bad." After trifling with her affections for months he left her for a more engaging damsel, who, to the vindictive joy of the abandoned one, also suffered in her turn.

For a long time she refused all propositions of marriage; the

very thought was hateful to her. Then came a misfortune. While she was off with a salmon fishing party, preparing the winter store of dried fish, her parents and entire family went southward to another village on their way to set their nets elsewhere.

During the salmon fishery it is against Eskimo ethics to boil water inside the house. It is bad for the fishery. The soup-pot was set near the beach and while the others were collecting bits of driftwood, the youngest child, a few years old, moved thereto by sorcery on the part of the Indians of the interior, threw grass and poisonous plants into the boiling pot. All ate and died. Poor Atleäk was thus left an orphan with no means of support; the inhabitants of the village where they died claiming the property left by her family, and doubtless converting such of it as was not destroyed at the interment to their own use long before the news reached Shaktolik.

She immediately claimed the protection of an only and very distant relative by marriage, in whose house she worked and by her neat sewing and constant industry kept herself supplied (through barter of work for skins) with clothing and other necessaries which were not hers by the communal bond of the tribe. Shortly afterward winter set in and she went northward with a party bound for Kotzebue Sound. It was a hard winter, the deer retreated to the most inaccessible valleys, the supply of fish failed. Her party finding that they could not rely on obtaining food at their various bivouacs, were obliged through semi-starvation to take a short cut to the Sound through the territory of the dreaded and hated Indians.

Traveling as rapidly as possible, one day they came upon a little open spot by the bank of a stream where were two Indian houses. The few footprints in the snow were of women's feet, and curiosity tempted the boldest to peep into one of the houses. The inhabitants were dead or dying of starvation. The men were seeking the deer far away. The women had denied themselves to save little bits for a child some two years old, whose thin cheeks were rosy compared with the wasted ones of his dying relatives. Death was surely coming to them, and after that what but death remained for the boy? They begged the shrinking Eskimo to take him and keep him, that his life might be saved. But the race-hatred was too strong and they had hardly food enough to keep their own party alive. One by one refused.

At last the girl who had lost her lover, who was an orphan (as

she thought) through Indian sorcery, took pity on him and said, "I have no husband to work for, I will take the boy; he shall be my brother, and when I am old I shall not be left alone."

So the Eskimo left the house of death and took the boy. From that time to the time I met her, her hands had been busy for him. He was then a lad of fifteen, bright, active and promising, and knew only the Eskimo life and tongue. His deerskin dresses were as handsome as any in the village and his foster-sister's activity provided for all his needs. Good was returned for (supposed) evil by the poor, ignorant Eskimo girl. She became indifferent to matrimony, since she had an object upon which to expend her love, and it is to be hoped that when age enfeebles her step and bows her athletic form, her adopted child will not forget his obligations. The essential features of this girl's career, at least so far as her love affairs are concerned, are they not duplicated in a dozen novels?

Another phase of life, which one might expect almost anywhere rather than among the Eskimo, I had occasion to observe there.

A young woman, really quite fine-looking, and of remarkably good physique and mental capacity, was observed to hold herself aloof from the young men of the tribe in an unusual manner. Inquiry, first of others, afterward of herself, developed the following reasons for the eccentricity: In effect she said that she was as strong as any of the young men; no one of them had ever been able to conquer her in wrestling or other athletic exercises, though it had more than once been tried, sometimes by surprise and with odds against her. She could shoot and hunt deer as well as any of them, and make and set snares and nets. She had her own gun, bought from the proceeds of her trapping. She did not desire to do the work of a wife, she preferred the work which custom among the Eskimo allots to men*. She despised marriage; held she had the right to bestow favors where, when and to whom she pleased, as fancy prompted, or not at all.

When winter came, having made a convert in a smaller and less athletic damsel, the two set to work with walrus-tusk picks and dug the excavation in which they erected their own house, which was of the usual type of Eskimo houses, walled and roofed

* It must be borne in mind that both sexes work hard, and labor is by custom equitably divided; the more severe work all falling to the men. The women of the family have often more influence in affairs of trade than the males, and there is no discrimination against them.

with driftwood covered with turf. It was, however, as additional defence against unwished-for prowling males, divided into two rooms with a very small and narrow door between them, next which lay some handy billets of wood to crack the sconce of a possible intruder. Here our two Amazons lived, traded and carried on their affairs in defiance of communal bonds and public sentiment.

The latter seemed to be composed half of disapprobation and half of envious admiration; while all the young fellows in the village busied themselves in concocting plans against the enterprising pair. These were too fully on the alert to be surprised, and all efforts against their peace were fruitless. They did not issue a "Weekly," dabble in stock or propose to run for office, but in other respects their conduct formed a tolerably close parallel with some that has been observed nearer home.

When the deer-hunting season came, the ladies were off to the mountains, and no sooner had they departed than disappointed lovers and an "outraged public sentiment" combined in a mob which reduced their winter quarters to a shapeless ruin. So far as my information goes, the following year they returned to the ordinary ways of the world, and gave up the unequal contest against a tyrannical public opinion, so far as their life of isolation was concerned.

I knew of several instances in which attractive young women, "crossed in love," led for at least two years (the period during which I was cognizant of their behavior) a life of celibacy which seemed likely to be indefinitely prolonged. These instances seem opposed to the mechanical theory of life among savage tribes which has of late been strongly advocated. It is true these Eskimo were more intelligent and less depraved than some other races of the same stock and than many tribes of exotic habitat. Still even among the lowest peoples it seems probable that individual energy, taste and opinion are by no means insignificant factors, and may have far greater influence on the common weal than is often taken for granted.

A mother's love for her children is characteristic even of animals, though with the latter it appears to cease with the maturity of the offspring. Among these Eskimo, however, in times of scarcity, if a child be born for whom food can hardly be provided, it is exposed to die of cold with its mouth stuffed with a bunch of grass to prevent it from crying. This is done as a matter of

duty, is considered perfectly justifiable, in fact as the only course consistent with common sense. The child must not cry or its voice will be heard about the house afterward. One of these children picked up and adopted by some one who can care for it, owes lifelong service to the foster parent. It has no property of its own except certain especial articles; it must work for its foster parent and bring to him any wage received for labor. It cannot marry without his consent, and for its life long, in one sense, is a bondsman.

Yet the children reared by their mother are treated with devoted tenderness and care. They are never punished. They receive the last food when others are starving. Their dress glistens with beads and fringes, while the parents can barely cover themselves from the cold. The boy is eager to become proficient in manly exercises. He must keep aloof from the girls until he has killed a deer. All play together until ten or twelve years old; then boys and maidens separate in their sports, except in the village dance house, and even there seldom take part until mature.

The bond of relationship, to fourth cousins, was always respected on the east shore of Norton Sound. It is not universally the case, however, as in the Kaviiak country, I was told, much laxity occurs. Except for this, until married, the communal bond, as in most American races, governs the intercourse of the young people.

Sickness is universally regarded as the result of sorcery exercised by enemies, either of their own race or Indians. This is the belief even when the real occasion of the sickness is clearly evident as it would seem to the civilized mind. When it is the result of particular circumstances, those circumstances were brought about by sorcery. A death in a house necessitates its destruction. Hence the dying, or those supposed to be, are usually taken into the open air unless they own the house and are its governing occupants. Death is often unnecessarily caused by this exposure. The prospect of a death will often make the chief person of a household flinty-hearted toward his housefellow, even if a relative or dear friend. An unusual succession of deaths will alarm a whole settlement and sometimes cause the abandonment of a village-site until not a resident remains.

After a death the women do no sewing for four days, and the men will not cut wood with an axe for the same period. A mother or wife will bewail the deceased for a number of days and

repeat the wailing afterwards at intervals, sometimes for several years. It seems to be in compliance with custom and independent of grief, which is often sincere and deep.

The wooden vessel used for a certain purpose, and of which every Eskimo owns one, is invariably placed over his remains and usually broken. Other property is left about him, differing in amount according to the panic, if any, caused by sickness at the time; to his whole stock of worldly goods or to the grief of the mourners. The personal property of a wife goes back to her relations if they claim it, or is given away to the community. The house-fellows or the community, rather than the relatives, are the inheritors of property; which is more likely in the latter case to go to brothers than to children or wife of the deceased. These house-fellows being the persons who joined forces to build, and who jointly occupy and own the house, form a little society subsidiary to the village commune. These subordinate groups have in domestic affairs considerable importance. The most important, oldest or wealthiest individual takes precedence of the others, and has always assigned to him the corner of the sleeping platform or space at the right hand of and next to the door. He settles disputes, directs the course of domestic affairs of the common household, meets strangers, assigns them their place on the sleeping platform and offers them refreshment by the hand of his wife. There is a certain allegiance due him by all inmates who also have certain duties toward each other.

This imperfect attempt at conveying some idea of the social thought and feeling of a barbarous people, may be followed hereafter by additional matter of a similar nature, but for the present I will close by sketching the daily round of an Eskimo housewife in early winter. Rising in the early hours when first a faint glimmer through the parchment cover of the smoke hole indicates the peep of dawn, her first care is to remove the necessary wooden vessels before alluded to, to the antechamber of the house where their contents are preserved for tanning and other useful purposes. This done she removes the cover of the smoke hole and searches the hearth, where carefully covered embers should still be glowing, and if they are not extinguished, carefully gathers them together, places some light dry sticks upon them and going outside arouses the sleepers by pitching down a quantity of fuel through the aperture in the roof. Before coming in she arranges some bits of wood or boards so as to aid the draught through the

smoke hole, and brings from some adjacent running spring a kettle of water for drinking and cooking purposes. Returning, the beds and mats are rolled up against the wall and the inmates perform their very simple toilets which consist chiefly in putting on their clothing, all of which except a pair of deerskin socks is usually removed at night. A few touches to their hair, a dry wash with a bit of cotton rubbed over the face, or at most with a little fine snow in lieu of water; after which bunches of dry grass are arranged in their boots to fit the foot, the boots are put on and tied, and they are ready for the day's work.

Meanwhile the housewife has prepared the materials for a meal of boiled deer, or seal flesh or of boiled fish with oil. The morning meal, always hurried, is seldom delayed to roast meat or fish on sticks, as at the evening meal. The house-fellows make short work of their breakfast and immediately disperse to visit their traps or pursue the avocations of the day. The remnants of the meal fall to the share of the dogs, the wooden dishes are usually hastily cleaned, and the mistress of the house sits at her daily work. This at this season usually consists in preparing deer skins for boots or clothing, or cutting and sewing the skins into garments. From time to time during the day a morsel of deer fat, a bit of dry salmon or some other fragment of food is incidentally discussed, but without any regularity. Since most of the women are similarly engaged in the morning there are usually few visitors until the middle of the day is passed, unless some girl bringing her work with her, comes in to sew in company with others, if her own house be empty of female associates. Chit-chat, scandal and very small small-talk make up the bulk of the conversation, broken only by directions in regard to work from the more experienced work-woman to the younger ones. As the day draws into afternoon some stranger from another village may present himself, when with few words he is directed to a sitting place, one of the women removes his wet boots and places them, and the straw pads they contain, in the smoke to dry, and something in the way of refreshment is at once offered to him. Silence reigns for a time when slowly, bit by bit, and at long intervals, the stranger tells the story of his journey, the latest news in his own village, and any messages he may bring to the household.

As night comes on, the sewing is laid aside, the smouldering fire is built up to throw out a generous blaze, and one of the

household goes up on the roof to look for the returning hunters or trappers with their spoils. Fur animals are the property of the trapper, but he can only claim exclusive right to the skin, sinew, fat, tongue, head and belly pieces of a deer. The remainder is distributed to any who may need it, or reserved as the common property of the house-fellows, if there are no other applicants. The wife receives her husband in silence, removes his belts and gun case, puts his boots to dry, offers him a bit of meat and fish, and when he has taken his accustomed place, calls his attention to the stranger while she prepares the evening meal. This is the event of the day. The oil lamp is trimmed and lighted; conversation becomes general; all eat together, served by the mistress of the house, and when the repast is over, tales have been told, and the fire burns low, the larger embers are tossed out of the smoke hole, the coals carefully covered, the parchment replaced to keep in the warm air, beds are unrolled, clothing doffed, and the inmates lay themselves head to the fire; the light is put out, and in a short time the silence is only broken by an occasional nasal indication that the hunter is enjoying his well earned rest.

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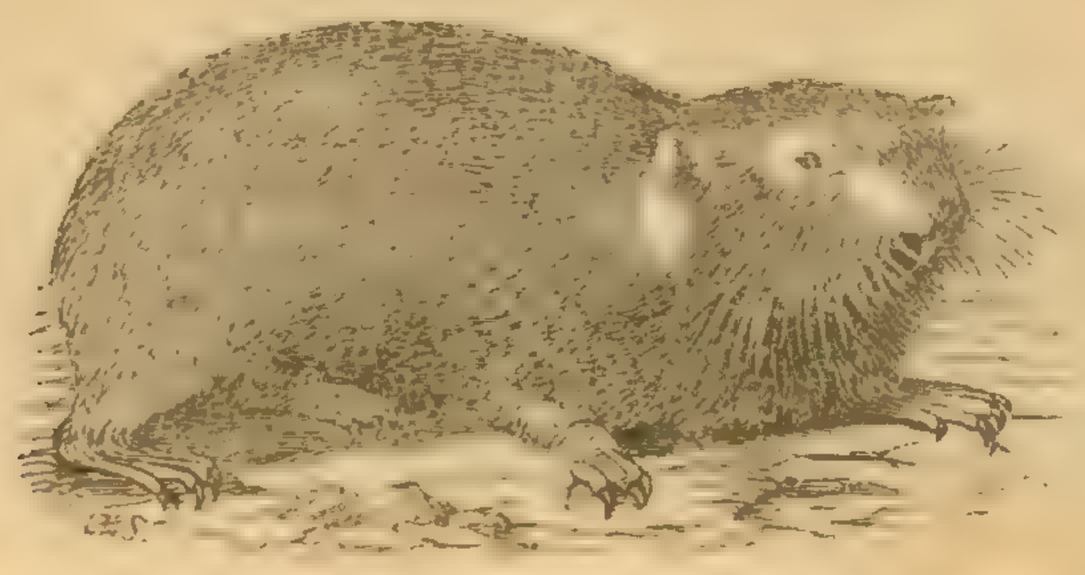
THE SEWELLEL OR SHOW'TL.

BY S. K. LUM.

IN the deep evergreen forests of fir, clothing the western slope of the Cascade Mountains, in Oregon and Washington Territory, is found a singular animal, *Haplodon rufus*, the natural history of which is but little known to scientists.

It is called by various names in the different localities it inhabits; considering it as new, each settler has named it after some better known animal he fancied it resembled. In Southern Oregon, it is found in moist situations on the tops of the Siskiyou and Rogue's River Mountains, and is there called "mountain beaver." On the head-waters of the many streams flowing westward to the Willamette River, it may be seen in great numbers, and is there called "mountain boomer," "ground hog," "gopher," "badger," &c. North of the Columbia River it inhabits nearly all the streams rising in the Cascade Mountains and flowing westward to tide water, also, on the Cowlitz and other tributaries of the Columbia, and in the vicinity of Shoalwater Bay. There it often goes by the Indian name of Shote or Show'tl. Its special habitat is the broken hilly

country forming an elevated bench some two thousand feet above the level of the sea, and lying along the western base of the Cascade Mountains. It is semi-aquatic in its nature, and its haunts will always be found where veins of water beneath the surface of the ground are abundant. It usually selects the open glades of the forest, thickly grown up with fern and sallal (*Gaultheria shalon*). It is emphatically a burrowing animal, and here the ground will be seen perforated with holes. Generally a little hillock of excavated reddish clay marks their entrance, but, sometimes, only a hole large enough to admit the animal passes directly downwards, the earth seemingly having been removed.* Beneath the ground, the various openings connect, and form a perfect "plexus" of passages, often nearly parallel with the surface, and only a foot or so in depth. Horses and cattle frequently



THE SEWELLEL OR SHOW'TL.

fall into these places, to their great annoyance, and the farmer in plowing such lands for the first time, finds much difficulty in getting his team to work. These underground passages, no doubt, extend to great distances, in proof of which, water has been seen falling into a hole in one place, and coming out at another a fourth or half a mile distant.

In many instances I found water coursing its way through these passages which had been worn by the water large enough to take in the body of a cow. Then, again, pools of water appeared beneath the surface of the ground, where the show'tls, young and old, took pleasure in sporting and performing their ablutions. The show'tl's food is the various vegetation of the locality, including shrubs, herbs, roots, etc. These it gathers in a hurried manner above ground, and drags them to the mouth of its burrow. It has been observed to ascend a bush two or three feet, cut off a limb quickly, and retreat with it to its hole. Often, a mass of dried sticks and rubbish may be seen about the entrance to the

* Perhaps such holes are made by the animal burrowing to the surface from below. —Ed.

hole, being the refuse of the gathering. I have known it to take possession of a field seeded down to red clover, forming numerous burrows, and seeming delighted to feed upon this herbage. Its strong and sharp teeth seem eminently adapted to cutting off sticks, as in the beaver, although I have observed none more than one-fourth to one-half an inch in diameter, cut off by them. Ferns, sallal and hazel form a large part of its food, which it masticates very fine, as may be seen by inspecting the contents of its stomach.

In general form and color, the show'tl has much the appearance of a huge meadow mole, thirteen to fourteen inches in length from the tip of its nose to the end of its tail, of a reddish color, and weighing three to three and a-half pounds. The males are larger than the females. The tail is short and almost hidden by the long hairs surrounding it. The eyes are small, and apparently but little use is made of them while passing through the burrows. Their whiskers are long and strong, extending laterally beyond their bodies. They have also bristles springing from their fore legs outwardly; these answer in a great measure the use of eyes by touching the walls of their burrows and thus directing their course in the dark.

Its fur is similar to that of the musk-rat, and but for the tail might easily be taken for the skins of that animal. It has no scent or musk that I can appreciate. I consider the flesh good eating, although it is not generally so esteemed by the people. The Indians eat them, and formerly made great use of them as food. Since the disappearance of the Indians from large sections of the country I think the show'tl is increasing in numbers. It is nocturnal in its habits, doing most of its excavating, feeding and moving about during the night. It is occasionally, however, seen above ground in the day time; when so seen it is extremely shy and wary, and will never be caught far from its hole. They move about considerably during the day time, as is evinced by being frequently caught in steel traps. They are pugnacious fellows, and will seize the nose of a dog, inflicting a severe bite. Enemies they have, no doubt, as minks have been caught in their burrows on the uplands, and wildcats, fishers, and other rapacious animals abound in their neighborhood.

I have found them associated with the digger squirrel (*Spermophilus beecheyi*), with which they seemed to be on friendly terms; indeed, the appearance and plan of the burrows of these two ani-

mals are very much alike, being frequently started under an old log and continuing under the same for its entire length.

They do not hibernate, but keep their burrows open all winter; beaten trails in the snow are often seen, leading above ground for a few feet, from one hole to another. They are able to gather their food at any time of the year, seldom going more than a few feet from the entrance of their holes to procure it.

I have never heard them make any kind of noise by day or night, save a kind of growl when caught in a trap. They are easily caught in steel traps, to the contrary of what many with whom I have conversed assert. I have caught numbers of them without even covering the traps. The No. 0 "Newhouse" trap is the one I have used. They are quite strong, and generally break their legs; and, if long in the trap, will be found dead.

A friend of mine had one domesticated for several months. It readily ate apples and other fruit, vegetables, etc., and seemed to bear confinement very well. It took great pleasure in paddling in a dish of water; slept most of the time during the day, but awakened to activity as night came on. Another man caught one while young, and let it run about the house. As it grew larger it dug a hole in the ground near the well, where it lived contentedly for a long time, when a strange dog killed it.

My knowledge respecting the breeding of the show'tl is limited and uncertain. People living in the vicinity of these animals tell me that the young show'tls just weaned make their appearance during the month of June, in numbers from three to five at a birth. The females have six teats. From my present knowledge of them I suspect they breed but once a year, like the beaver.*

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THE MICROSCOPE AS A MEANS OF EXAMINATION OF ROCKS AND FOSSILS.

BY DR. R. FRITZ-GAERTNER.

THE examination of rocks in regard to their lithological character is accompanied with great difficulties whenever their composing minerals are so minute and so thoroughly intermingled

* On the habits of this animal compare also: *Coues*, Monograph of Rodentia of North America, 1877, pp. 590–598; *Matteson*, Am. Nat. XI, 1877, pp. 434, 435; Murphy, London Field for May 5, 1877.—E. C.

with each other that one even by aid of the magnifying glass cannot recognize them.

A compound rock of such minute structure may appear to be a homogeneous one, as the individuality of its minerals is lost, in comparison with the whole appearance of the rock. The chemical analysis of the compound will not furnish an adequate representation of its mineralogical composition, but will only give some figures of its elements, after which we classify the rock under examination by comparison with a group of rocks, with which it has the greatest resemblance in its chemical composition. At the same time we have to remember that there are rocks which are of the same chemical composition, and yet their mineralogical constituents are different from each other. True, chemical investigation has helped us to gain some valuable points according to which we may form some idea of the composing minerals, but not of their physical qualities, *i. e.*, in which state of molecular arrangement they may be, and how they adhere to each other. Chemical analysis is therefore not a complete survey of the lithological nature of the rock; the task laid upon chemistry by lithology was too heavy, as the former destroys the architecture of our mineral aggregate, instead of examining it. We should therefore not wonder that this result of chemical investigation could not be used as a firm basis for lithology and geology.

A great number of rocks, mineralogically different from each other, were treated and named according to their chemical composition as one kind of rock, whilst lithology on the other hand unnecessarily enriched its nomenclature by giving to one and the same rock (the structure of which presented itself in various forms) different names.

The study of palæontology without the aid of the microscope was limited, as it could only treat, in its description, of facts visible to the eye. We know by experience that nature by the process of petrifaction has not only preserved the macroscopical forms and organs of those fossil organisms, but also their microscopical one. These minute remains whether only organs of a macroscopical fossil or an organism by itself, rightly deserve to be studied with the same industry and endurance, with which their larger fellow organisms are favored; the more, as we know that the microscopic organic world takes and has taken an important position as architects of the sedimentary rock of our earth. The researches of the palæontologist enable him to meet

with forms of which it is difficult to decide without the aid of the microscope and some preliminary preparation of his material, whether they have to be treated by the lithologist or palæontologist. A chemical analysis will not disclose their origin, whether by mineral accumulation or organic life. Usually they are left to the lithologist who, not long ago, claimed all the fossils as freaks of nature. A great number of those interesting forms are generalized with oolites, concretions, etc. The unsatisfactory results obtained by the limited macroscopical and chemical analysis of rocks and fossils, induced Dolomien and Cordier in the last century to advocate the use of the microscope as a necessary and important instrument for investigations in geology. But their efforts failed to secure to the microscope an acknowledged position in the laboratories of the lithologist and palæontologist. This failure has to be principally attributed to their defective mode of preparing the rocks for the microscope. The examination of the rock consisted mainly in viewing its natural fracture or polished surface by aid of reflected light, as the opaqueness of the material did not allow the use of a transmitted light. This imperfect method could not be of much service.

Another method of preparing rock material for the microscope was to crush it to a fine uniform powder, which by decantation with water was deposited according to its specific weight. The minerals composing a compound rock being of different specific weight, they separated in beds or layers, which contained principally one and the same mineral. The minuteness of the powder allowed it to be viewed under the microscope with transmitted light. In most cases the minerals could be recognized either by means of the magnifying power or by aid of chemistry, which analyzed the separated layers by themselves, but which in reality do not always consist of fragments of the same kind of mineral, but are also partially mixed up with each other. The chemical analysis could not be entirely depended upon, but had to be verified by microscopical observation. The greatest drawback to this method of rock analysis is the entire loss of structure during the grinding process. And although Ehrenberg, by this method of examining rocks in form of dust, achieved his famous results of the micro-fossil organs of the chalk formation, yet the microscope remained for a long time of only limited use.

The great reorganization of lithology which has recently been

accomplished by Sorby, Zirkel and Rosenbush may be attributed to the introduction of thin sections of rocks for microscopical analysis. These sections are ground thin enough to allow the use of transmitted light, and although but a small slice of a rock be examined, it reveals their composing minerals and their structure and also their accessory aggregates.

The structure and means of cementing of rocks is clearly represented in the various sections made in various directions.

The base of a rock is by aid of the polariscope readily decyphered, whether it be crystalline or amorphous. The base of porphyry is composed of minute particles of feldspar and quartz. Basalt was found to contain sometimes enclosures of a glassy character, which in many cases are so large that they assume the aspect of a base through which the crystalline part is scattered, and rocks which were always considered as amorphous, were shown by aid of thin sections to be in a state of crystalline formation.

One of the most interesting features of lithology is the chapter treating of the cause and result of metamorphic changes in rock. A section of an altered rock presents in itself the whole story of a process which for a long series of years must have been working to produce a chemical and physical alteration in those solid bodies. We learn by the study of the thin section with the microscope, which of the composing minerals was at first disturbed and changed, and how the progress of change in the molecules was gradually spread through the whole mass. The well-known rock, serpentine, may illustrate this. A section presents outlines of crystals which are on the borders serpentine, but which in their centre enclose a clear and unaltered nucleus of chrysolite, the remainder of the chrysolite crystal, the form of which is preserved in serpentine. Further, basalt carries chrysolite as one of its most common accessory minerals. Nearly all these chrysolites are in a state of metamorphism, their outlines showing bands of serpentine, similar in structure to the serpentine occurring in large masses and the origin of which has been found to be in a compound rock changing by the chemical and physical alteration to a homogeneous one.

A careful microscopical study of rocks and minerals of a country enables us also to trace the original rocks which furnished those immense layers of drift clay, which when prepared for the

microscope appears as a mass of debris of rocks altered by mechanical means and pseudomorphical actions.

The study of thin sections of rocks has also widened our knowledge of the more frequent occurrence of certain minerals as micro-mineralogical accessories, as magnetite, menaccanite, apatite, hornblende, tourmaline, nepheline, nosean, microlites, and many others.

It is also due to microscopical researches that crystallography and mineralogy have been abundantly enriched in facts which may be of the greatest importance for their development as sciences. What we formerly thought to be a single crystal has shown itself as a number of crystals in position of twin formation. A great number of crystals, principally quartz, have been found to be porous, the pores filled with liquid, most likely water and carbonic acid, and these pores are the most frequent if quartz occurs in granite or syenite.

Orthoclase presents under the polariscope two systems of bands crossing each other at right angles. Labradorite is filled with menaccanite and magnetite; and mica and magnetite generally pierced with apatites when occurring in granites, or in diorites.

It is not the intention of the writer to describe all those results of micro-lithological researches which within a few years have reorganized lithology and richly contributed to geology, mineralogy and crystallography. The remarkable work of Prof. Zirkel, forming the sixth volume of the Report of the United States Geological Exploration of the Fortieth Parallel, under the direction of Prof. Clarence King, Geologist-in-charge, will demonstrate at once the importance of thin section in lithological researches.

Palæontology likewise has derived a great many new facts, as will be seen in a forthcoming volume of the "Palæontology of the State of New York," by Prof. James Hall. A great number of sections of corals and sponges and other fossils have been prepared and illustrated. The result derived from its perusal will show that palæontology also has progressed as much as lithology by the adoption of thin sections and the microscope as a means for the study of fossils.

THE SPRINGS OF SOUTHERN NEVADA.

BY D. A. LYLE, U. S. A.

IT is the intention of the writer to merely jot down a few personal recollections of some of the springs visited in the arid region of Southern Nevada, while a member of one of the Wheeler expeditions.

To those who have experienced the pangs of thirst, while journeying over the desolate wastes that characterize this section, it will not be surprising that reminiscences of water should linger longest in the memory of the traveler. In fact the procurement of that necessity is a matter of such vital importance that all movements are subordinated and controlled by the answer to

Fig. 1. Mud Springs.

the question, "Is there any water there?" Should the reply be in the negative, some other route must be followed, or else a supply of water must be carried along. The springs in this portion of the Great Basin are few, and often far between. Their waters differ much in quantity, temperature and chemical composition. In quantity, the yield varies from a few gallons per day to a never failing supply. As to temperature, the heat of the waters range through cold, cool, tepid and warm to boiling. As regards chemical composition, some are fresh, others alkaline, and still others, sulphurous. In the waters of some springs, a mere trace of saline ingredients are found, while in other cases the salts are present in sufficient quantity to produce saturation.

The first that will be mentioned are Mud Springs (Fig. 1), also

known as Desert Wells, from the fact that parties passing that way, have dug pits from four to eight feet deep when there, in search of more water. These springs, when visited by the writer, were mere pools of muddy slime, with a slight film of stagnant water overlying the viscous blue marsh. So nauseous were these waters that neither men nor animals could drink them. Enough water, however, was obtained by digging new pits or "wells" near by, to partially alleviate the sufferings of man and beast, which were somewhat intense after marching over thirty miles through the heated sands of the Smoky Valley Desert upon a July day.

These springs—if springs they may be called—were situated at the southern extremity of Smoky Valley surrounded by a dreary waste of sand and "alkali flats," with here and there a stunted sage bush.

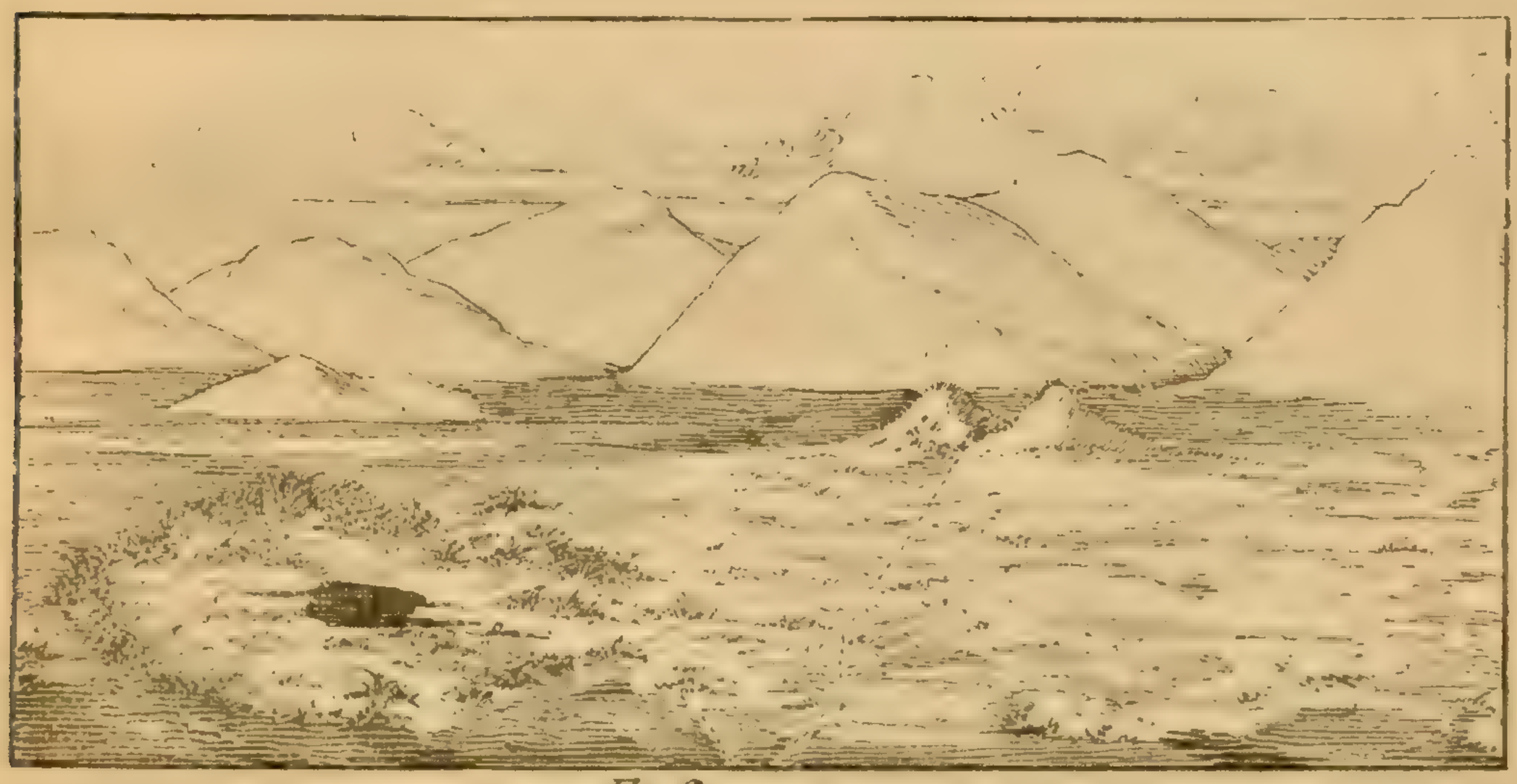

Fig 2.

Day break the following morning found the party en route to Silver Peak, the next objective point. Silver Peak, a small mining camp, is located near the west side of Clayton Valley, and at the eastern base of the Red Mountain range. Near this place and along the western border of the salt marsh which forms the major part of the basin are the Thermal Springs. The more important ones are eleven in number. With one exception they are contained in a narrow belt, running almost north and south. This belt is about a half mile in length, its width being but a few rods. Beginning at the southern limit of this line, the first spring we encounter is in a small depression in the general surface. (Fig. 2.) Its waters are slightly saline, but quite palatable, and are the best for use in the vicinity. The

temperature of the water is 69° Fahr. Just north of this is found a cluster of springs; the largest and most central one is called Saturn. (Fig. 3.) Their temperatures are 69.5° Fahr. These springs are in close proximity to each other, and flow out upon a level area some twenty acres in extent, covered with a rank growth of coarse salt grass, from whence the water flows into the salt marsh.

Proceeding northward, we next meet with three salt springs arranged in the form of an isosceles triangle, differing widely in temperature and the degree of their saturation.

These are situated in the edge of the salt marsh, the two forming the base, being in an east and west line, twenty feet apart. The more westerly one has a temperature of 79° Fahr., while the other one in its quiescent state has a temperature of 117.8° Fahr., and at irregular intervals boils and emits steam. The third,

Fig 3 Saturn Spring.

forming the apex of the triangle and lying ninety feet north, has a temperature of 116.5° Fahr.

Still further north are two more salt springs, situated also in an east and west line, only four feet apart; the westerly one, as before, having the lowest temperature, being 79° Fahr., while the other has a temperature of 117° Fahr. Another spring (Fig. 4), about one fourth of a mile north of the others, was constantly boiling and emitting steam. A gurgling noise could be heard in several places near the main opening, under the tufaceous crust of calcareous matter deposited by its waters. In approaching this spring the greatest caution had to be exercised to avoid breaking through the crust of tufa which bridged and in part, concealed the seething waters, which could be seen through the many perforations in this treacherous envelope. Every step in

advance was carefully tested by striking the tufa with a mining hammer, to see if it would bear the weight of a man. Thus, by slow degrees one or two members of the party succeeded, without accident, in reaching the main opening, which was about five feet in diameter. Regard for personal safety, however, soon overcame scientific curiosity, and the retreat was accomplished by separate routes in the same cautious manner, to avoid getting too much weight upon any one place. The waters were found to be impregnated with soda, lime and borax.

In the immediate vicinity of the hot springs were found numerous concretions, either on the surface or slightly imbedded. These had generally a prolate spheroidal form, although many eccentric shapes were seen. About half a mile out in the salt marsh was a remarkable spring (Fig. 5), nearly twenty feet in diameter. The water rose to the height of several inches above

Fig. 4. Boiling Spring.

the general surface, and was retained by a ring of earth elevated a foot above the terrain and thickly set with *tules*, a kind of rush, whose verdancy contrasted strangely with the sombre gray around, and gave to it the appearance of a miniature oasis. The water was quite clear and nearly fresh; this latter property was probably only apparent from the contrast, after imbibing the more brackish water of the other springs; its interior cylindrical walls extended to a depth of about five feet, below and under which, as far as could be reached by a pole, nothing like earth could be felt. There appeared to be a subterranean lake beneath the salt-marsh, of which this spring was the only visible portion. As to its depth we had no means of determining it; the temperature was 69° Fahr. The circumjacent earth was a mere superficial crust, five or six inches thick, which was springy beneath our tread, and breaking through which one sank into the viscous

mud. In walking over this area the ground constantly jarred and trembled, thus indicating the elasticity and instability of the indurated envelope. Even on the road near our camp, west of the marsh, when animals traveled over it, a dull, hollow sound was heard, bearing out the hypothesis of the existence of a subterranean cavity. The plain is crossed in two or three places by roads and trails; and should animals get off these, theybreakthrough and often become submerged in the mire. At one or two places shallow trenches or vats have been scooped out, and the salt water collecting and evaporating in them leaves the walls and bottoms covered with beautiful crystals of pure salt.

Fig. 5. Section of Spring in Salt Marsh.

Traveling westward from Silver Peak, a distance of eleven and three-fourth miles, during which the Red Mountain range is crossed, Mountain Spring is reached. This spring bubbles up at the foot of Red Mountain peak. The water is clear, cold and not in the slightest brackish. Its appearance was hailed with joy by men and animals. At last water had been found that would slake instead of increasing thirst. Here, in the short interval of less

than ten miles, the physical characteristics of the water supply had radically changed.

On the east side of the Red Mountain range the springs were thermal, brackish, and often nauseating, while on the western slope they were pure, cold and refreshing.

A few miles west of Red Mountain Spring, in a dry ravine,

Fig. 6. Mamie Spring.

through which the traveler passes to reach Fish Lake Valley, is found Mamie Spring. (Fig.6.) The water is excellent and plentiful. Its situation is rather unique. In the bottom of a dry wash lies

a very large boulder of conglomerate, or more strictly of breccia, transported from some distance, from the under side of which the water of the spring gushes into a little pool or basin it has made for itself. From this basin the water, overflowing, traverses for a few yards the gravelly bed of the wash, when it sinks and is seen no more. The huge boulder that shadows this little basin with its overhanging edge is mainly composed of a very hard arenaceous matrix, in which are seen imbedded many rounded pebbles of various sizes, and also large angular fragments of rock. The most remarkable thing about this spring was the fact that it had only been running about two years, having suddenly sprung into existence, the miners said, since they had been in the vicinity.

Fig. 2. "Mound" Springs.

Upon the eastern edge of the Amargoza Desert is quite a large area called Ash Meadows; so named from a small species of ash tree growing there. The meadows are covered with good grass and are well watered by numerous warm springs.

The principal spring was about thirty feet in diameter and situated at the foot of a small butte. The water issued from the bottom, through a tufaceous mass of rock.

It was about four or five feet deep and was cooler than the other springs. The stream of water that flowed out was five inches deep and two feet wide,

Fig. 8. Las Vegas Springs.

and clear as crystal. The sides and bottom of this spring were covered with a white, chalky-looking deposit, that gave a milky tinge to the water when stirred up. A few small fish were seen in this spring. Many of the springs in this vicinity contained quicksand.

South-east of Amagoza is Pah-rimp Desert. About the middle of the upper end of this dreary waste of sand and sage bushes are several little oases bountifully watered with exhaustless springs, some of which are very large, and the confluence of their waters forms quite a large creek that flows off towards the south-west, but is soon lost in the sand. Splendid grass abounds along the banks of this water course. Immediately around the springs a band of southern Pah-Ute Indians is located, and by irrigation succeeds in raising a quantity of corn, squashes and watermelons. Willow trees and wild grapes are indigenous, the latter growing in the greatest abundance.

Mound Springs. (Fig. 7.) By this appellation it is proposed to designate those springs situated upon small mounds rising above the general surface of the country surrounding them. The most prominent mound noticed by the writer was upon the Vegas plains in Southern Nevada; its base was circular and

about twenty-five feet in diameter, it was fifteen feet in height and was covered with "*tules*" and coarse grass. Several small sulphur springs oozed from its nearly flat top, and provided moisture for the tangled vegetation.

It appeared as if built up by the partial decay of organic matter and the depositions of these numerous springlets. The soil was tremulous and yielding to the tread, and resembled in that particular the sphagnous bogs of Alaska. The fumes of sulphuretted hydrogen were strongly apparent even at some distance from the mound.

A short distance beyond the mound above-mentioned, occurred the Las Vegas Springs (Figs. 8, 9), the largest of which was ap-

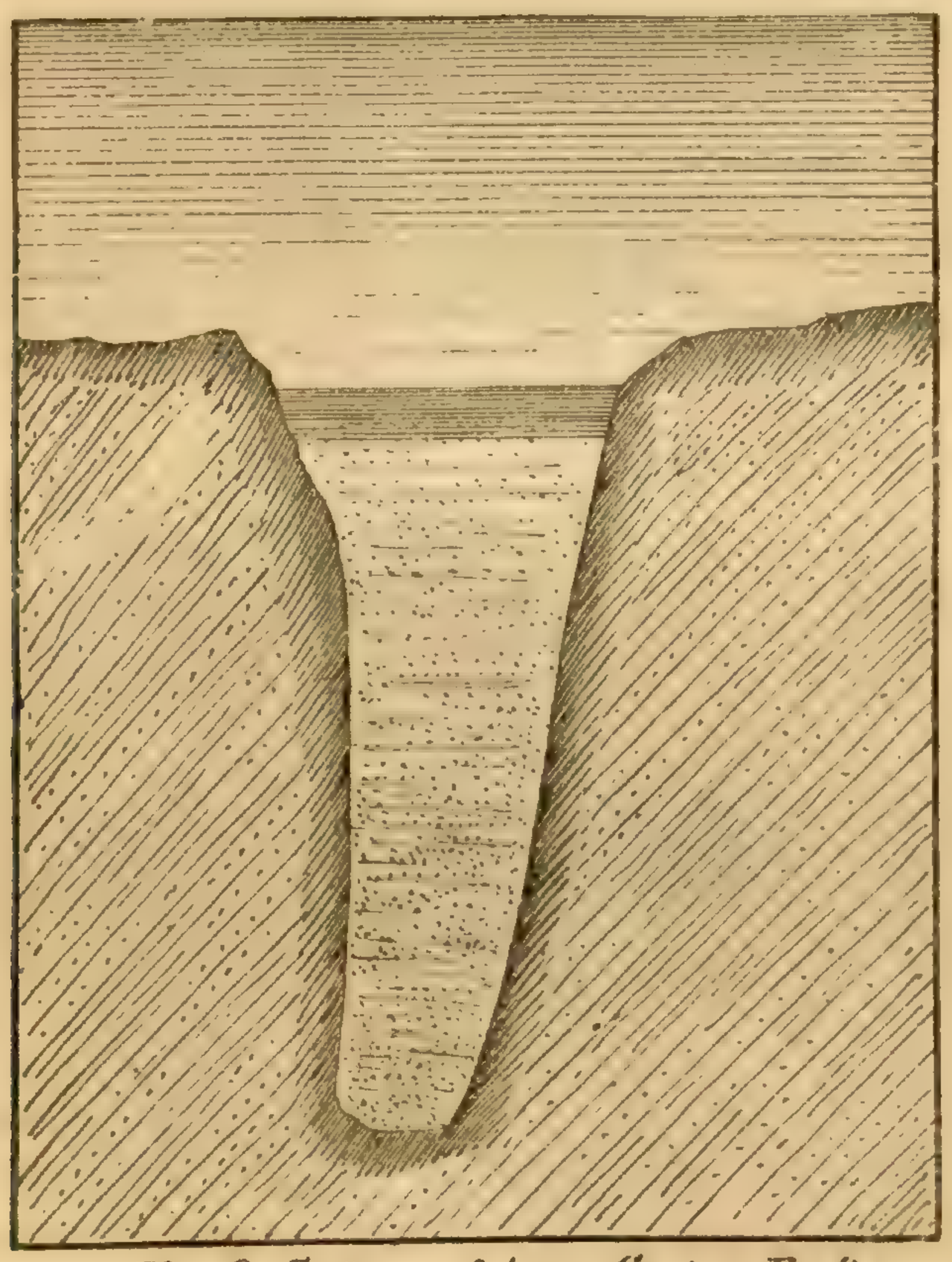

Fig 9. Section of large Spring. Fig 8.

parently about three feet deep, with white quicksand constantly "boiling up" from the bottom. Quite a large creek issued from it and ran in a south-easterly direction for a mile or more. This spring had been regarded by the Indians and squatters as a rather supernatural one, and among other improbable legends was said to be bottomless. This myth, at least, was exploded when a sixty pound weight tied to a cord was used to sound its depth. This weight sank eighteen feet and three inches through the ever

varying quicksands, and then came to rest. Further on ran the other springs which also poured their waters in the creek flowing from the first one. On the left bank of this creek stood an old *adobe* enclosure, rectangular in shape, built by the Mormons some years before.

Two or three large cottonwood trees shaded the creek near the quadrangle. Here the bed of the stream was broken into a series of little rapids or falls, none exceeding four feet in height, formed by rocks of calcareous tufa.

At the foot of these miniature waterfalls was a quiet pool, about five feet deep and ten feet in diameter, used in former times by the Mormons as a baptismal font. The land along the banks of the creek had been cultivated, and at this time were seen the remains of irrigating ditches, which attest the industry and enterprise of this strange, and to our minds, deluded people. These fields are now overgrown with mesquite and thistles, the latter attract numberless goldfinches, humming birds and humble bees.

In the springs above enumerated, the reader has a sketch of a few of those in Southern Nevada. The springs of this inhospitable region are so few, that at one time or another, each one becomes, as it were, the polar star of the desert traveler, towards which he turns his face with inflexible determination.

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THE NIGHT HERONS, AND THEIR EXODUS.

BY REV. SAMUEL LOCKWOOD, PH.D.

AMONG our showy birds, although far from graceful in many of its movements, is the night heron (*Nyctiardea gardeni* Baird). If fine feathers make a fine bird, then assuredly our *Nyctiardea* deserves consideration. The bird when adult is fully two feet long. It has a deep guttural cry, consisting of one syllable, slowly repeated. This circumstance afforded the old name given it by Nuttall, *Ardea discors*, as also its popular names of qua-bird, or quawk. It is also known as the black-crowned night heron, the crown of the head, and considerable of the back being a very dark green, almost approaching black. In the nuptial months, the bird flourishes from the hinder part of the head, flowing backwards, like so many natural "accidentals," three very delicate white

plumes, nearly ten inches long. If I might change the simile, these pretty white filaments are suggestive of the white streamers pendant from the chignon of some fantastic bride. And the two sets of adornments are afflicted with a similar perverseness; for the bridal toggery of the one will insist on getting twisted, and *Nyctiardea's* nuptial head-gear also will snarl into one. But in this instance the thing after all is quite natural and becoming. Each of these white, almost thread-like filaments, is nearly cylindrical, owing to an incurving of the edge of the feather; hence the three do have a habit of slipping into one another, and making, as it were, a pretty imbricated cord or cue of ivory whiteness. The general coloring of this showy bird is such as neither pen nor pencil can quite portray. Says Coues, who is a fine bird painter, when verbal pigments are concerned: "General plumage bluish-gray, more or less tinged with lilac; forehead, throat-line, and most under parts whitish." The bill is black, and the feet are yellow. You will find nothing verdant in the eyes of the night heron, although the space between them is of a greenish blue. As to the optics themselves, they are red. Does some one insinuate "that is the way with night birds?" Let such an one consider that generally the owls have bright yellow eyes.

It was three years ago, just as June, the busy bird month was opening, when, accompanied by two of our students, I set out for a visit to a famous heronry, some three miles in a south-west direction from New Brunswick, N. J. The neighborhood is called Three Mile Run, because of a tiny stream about that distance from the city. We went first to the farm house near by, where a colloquy something like the following occured:

Self. "Do you know when the herons began to settle over there?"

Hostess. "Well, sir, you see it is so long ago since the herons came, that it really is not possible to say when they did settle, but they've been there 35 years to my certain knowledge."

Host. "Oh, wife, more than that: I remember them over 40 years; and there was father, who had known them long afore that. I'll be bound that heronry is 50 years old if a day. And since I've known them they've come and gone every year, never missing once."

Self. "Is that all the woods there were?"

Host. "Bless you, sir, no. Once that was as pretty a piece of oak woods as one need put eyes on. It covered many acres, and

we called it the Swamp. Just that grove where the herons are is all that is left of it. We never attacked the birds, so I suppose they got to understand us, and to know that they were welcome. The felling the timber and tilling the land has pretty much done away with the swamps. You see, there's only about two acres in that grove. But the herons were a good deal more numerous when the woods were bigger."

Hostess. "Yes, I remember when it was a'most deafening to hear them."

Host. "When we see them coming back in the spring, we know that corn-planting is nigh; and when they leave in the fall, it is usually time to husk."

With the two young men I now started for the heronry, but five minutes' walk distant. It was evidently once a swamp. The grove was a remnant of a large wood of red oak, *Quercus rubra*, and, as already stated, did not cover quite two acres of land. With an exclusiveness not unlike that of some wasted Indian tribe, these red oaks kept out every other kind of tree. They even pressed upon one another so closely, that the lower branches after a precarious growth, inevitably died and fell. Atrophy of the lower limbs was the invariable habit. Thus the trees with a small girth pushed up towards the sky, each one a slim mast about fifty feet in height, with a small dome of shining green leaves at top, the base of each little dome crowding upon its fellows. It looked to me like a garden supported on piles; but as the wind sprung up there was such a wave-like movement overhead, that I wished for a balloon view, when I fancied I should see an emerald ocean floating in the air.

But if in mid-air was a scene of beauty, one of quite another character was soon to greet our eyes. Everywhere in the grove the ground seemed as if plashed with drippings of whitewash. And the leaves and twigs of the scanty underbrush were stained with these unsightly blotches of white. This was the effect of the droppings of the birds, both the old and the young. It indicated a large consumption of food; and if fish makes good brain food, perhaps this may have some bearing on the commendable circumspection of these occupants of the top flat in this establishment. I was led to look for some peculiar effect on the plant life of a soil so dressed annually for a half century. But I failed to detect anything noteworthy.

As we entered the wood there arose a grand commotion. An

old bird, perhaps the patriarch of the tribe, sprang into the air with a startling qua! which, after a pause as if to gather assurance, was repeated—Qua! qua! qua! Up flew another, and another; then many, all joining in the one wild out cry of qua! qua! qua! as they circled in air, loath to let their nests be out of sight. It was a wild chorus of alarm, utterly unmethodical, but perfectly uproarious, while over the edges of the rude nests of sticks peeped hundreds of little callow heads in mute astonishment, as if to see what could be below to incite so great a tumult above. Almost in the heart of that small grove I counted fifty herons' nests. These nests were high up in the leafy domes already spoken of. In some instances I noted three, and even four nests in one tree. Some writers I find saying that in the breeding season, the qua-bird is less suspicious. Assuredly it seemed to me that these herons could not be more circumspect. To come upon them by surprise was just impossible. From a distance no one can see them in their leafy outlooks, but they can see you; and should one approach too closely, the nearest male bird will give the alarm.

I noticed that the females whose incubation was not completed did not leave their nests. I have no doubt that they were waiting further signals from above.

Query: What notice of change in the situation can a bird give whose whole vocabulary is contained in the one monosyllable, qua? But do not philologists tell us that in some of the dialects of "The Flowery Land," that even a monosyllabic word may have eight significations if spoken in so many different tones? Thus if a barbarian outsider might be allowed to improvise a bit of barbarous Chinese, one might say shoò, to mean lovely, or all right; and shoó, to signify awake, or all wrong. And pray why not as much in the bird lingo?

Here let me mention an incident. Not knowing that one of the party was behind us making a feint of climbing a tree with a nest in it, there was observed an increase of commotion in the air. To a question what are the quas doing, the answer returned was: "They are taking a bird's eye view of the situation." I requested the aspiring youth whose conduct had intensified the stir above, to climb the tree and get a young one from the nest, that we might see it. Now began that change in the bird talk. It was qua! still, but in a different tone, and one which was understood by the sitting birds, for they spring from their nests and

joined their companions in the air. As the youth neared the nest the wild monotonous cry became painful to me, and I was anxious to shorten the suspense of the poor birds. Clinging to the tree with both legs and one arm, with the free hand he took a young bird out of the nest, and held it at arm's length from the tree, that I might see the callow thing, which was about as big as a fat squab. I saw it—yes, and I saw more than I looked for. The downy little beast vomited upon me the topmost layer of his night's feeding. And even my philosophy sold me, for concluding that the mischief was done, I stood my ground, but the mischief was only begun; for after an extraordinary pause, layer number two, in a more advanced stage of digestion descended, which in a hurried manner I declined to receive. After another pause, the third and last installment followed. We now called to the young man to put the unmannerly little thing back in the nest. It had thrown up the remains of six fishes.

The above incident was called "a sell," and subjected the writer to some chaffing at a later date. Said a wag, as if in quest of knowledge—"Why does a young qua-bird vomit his dinner upon being disturbed"? To this the answer was: "I do not get it from observation, but have it from tradition, that some of the herons when pursued by the raptors, keep up a series of diversions by vomiting the contents of their stomachs in installments, much as the Russian dispenses the contents of his sleigh when pursued by wolves." Now what the young heron did, was done from mere instinct—not offensively, subjectively considered, although objectively it was offensive enough—but as a protection by way of diversion. That is, the young bird acted wholly from an automatic impulse of instinct. And what is instinct but inherited experience after being crystallized into habit? In a word, the frightened young quawk, simply did in a blind way what its ancestors had done with better methods. If there had been enough intelligence in that instinctive act to indicate purpose, then the intention would have been as against the youth who held it as a captive, and not at all as against the spectator of the act.

Although they indulge in varied food, yet these night herons are nocturnal fishers, and their fishing must be limited to the margins of streams, and in waters decidedly shallow. They sally out at twilight, though sometimes if the day is cloudy and dull, they will not wait till then. As they pass near, and sometimes over the farm houses, on their way for food, they indulge in their

peculiar cry, the effect of which on the stillness of the night, is somewhat weird; still it is neither so ghostly nor so ludicrous as that of the classic bird of night. And very industrious must these night fishers be, for with a voracious appetite of their own, and a good deal of really hard work to be sustained, their young also consume an enormous quantity of food.

In connection with the fishing of the night heron, I found a very curious item of belief among these persons whose acquaintance with the habits of the birds of this heronry reached so far back It was this: that the quawk when fishing in the night stood in the shallow water watching for its prey, and was aided in the matter by a soft light which emanated from its legs and feet. We had heard of luminous understandings, but they belonged to the higher vertebrates. I was assured that this phenomenon had been witnessed, the observers being out coon hunting on a moonlight night, and I was asked if these birds had not the capacity of emitting light from some phosphoric source in the legs, in some analogous manner to the phosphoric emission of the fire flies, or lightning beetles. Having in a modest way expressed my doubt as to the phosphoric hypothesis, I ventured to suggest that the yellow legs of the bird when withdrawn wet from the water might have shone, reflecting the moonlight. But the phosphoric hypothesis held its ground, being regarded, and perhaps rightly, as the more erudite of the two.

My pupil, who climbed the tree to show me the young bird, a little later in that same season, secured one of the fledglings, which he successfully tamed. It became an interesting pet, though hardly of the amiable sort. It had the run of the premises, especially of the barn yard; and was blessed with the appetite of a glutton. To this insatiable craving, fowl, flesh and fish were alike acceptable. Though descended of kindred who had always wintered in the warm southern climes, the bird stood the winter, a severe one, admirably. In this way it met with experiences which were not at all inherited, and decidedly novel.

It hugely relished soft fresh meat when cut into convenient morsels. The same meat hung in the barn would get frozen. In this condition it had to be cut up with a hatchet. A bit of frozen fat thrown to the bird evoked conduct of a humorous character. Suspecting nothing, the bird went for the coveted morsel, when, after some queer contortions the half-swallowed delicacy would be suddenly eructed with the quaintest demon-

strations of astonishment and distress, much as a child who on an extremely cold day in winter, dancing with pain, complains that the door-knob has burnt his fingers. But though embarrassed by the situation, the young qua would repeat his efforts to get the frozen meat well down, until success resulted, when he would come for more; so that in this conflict of bird thinking, the judgment that the meat was good prevailed. In fact, this bird's experience with frozen meat was not unlike daft Jerry's first acquaintance with ice cream: "This pudding *is* good; but such a pity it got froze!"

A very impudent, bossy bird, did the young qua grow up. Through the winter months the arena of his daily exercises was the barn-yard, which also was the scene of occasional night activities quite annoying to the more orderly disposed denizens of the place. His movements, even when "feeling good," were always awkward, and in no sense graceful; while from the depth of his inner consciousness was evolved a conduct so absolutely graceless as to almost indicate a deep-seated depravity. He would pursue the domestic animals, harrying the poultry and the old dog, presenting his formidable bill to those who owed him nothing, not even their good will. He knew his young master well, and paid him a sort of deference which he did to no one else. But though there was a kind of attachment, affection there was none. In fact his master was simply his feeder, to whom he was drawn by a very active appetite; this craving for food satisfied, even his keeper was but little more to him than other folks.

At length the cold season was over, and my young friend was glad to know that he had wintered his charge safely. He had begun to speculate how much longer he would have to keep the young qua bird ere it would attain to the plumage of its parents. The spring is well advanced, and the pet is about ten months old. See it is looking skyward and southward. Nay, it seems listening. Sure enough, the cry of qua! is heard in the air. The herons are coming. That cry is from the avant courier of the returning community. As the young bird looks up it is evidently undergoing a change in its feelings. There is another cry as if from the second outrider of the approaching host. The pet heron seems well nigh beside itself. It has never seen the "sunny clime," but it has caught that mysterious passion, the semi-annual frenzy of these birds. Its bird nature seems suddenly developed —and the bird soul is now above pellets of frozen mutton, **and**

the communion of fowls and dogs. Now the qua cries are thickening in the air, and the herons are coming fast. All this is too much for the young bird, so he is on the wing too to join his tribe. Albeit kindnesses received, he has cut himself from the white man and his ways. One would like to know how, with his superior education, this young person conducted himself; also how those illiterates, the old quas, received him. Well, this much must be said, as affairs will prove in a few days—the youngster has rejoined his tribe on the eve of an event the most remarkable in its history, one which might afford scope for the best exercise of bird wisdom, whether inherited or acquired.

On my table, at this writing, lies a pretty egg, which seems to give inspiration for my task. It is really beautiful for its symmetry, also its one attractive color, with neither spot nor stain. The larger diameter is fifty-two m.m., or two and one-sixteenth inches; the lesser diameter is forty m.m., or one and nine-sixteenths inches. Of the color I should have said above, it is a lustreless, waxy pea-green; though some call it a sea-green. And what an interesting object it is to me! and how sad is this interest! At the beginning of June in our Centennial year, 1876, my pupil who acted as guide to the heronry, brought me this egg, and with it the startling intelligence that the herons had gone! The community returned at the usual time, and had begun nesting. It happened that trade being dull in New Brunswick, many operatives were out of employment, and of these, not a few spent their time in a wanton destruction of the birds. Some went to the heronry, although strictly private property, and near the homestead of its owner, and in despite of his earnest remonstrances, a few shots were fired in the heronry. I am told that not more than two herons were killed. Had this happened away from their nesting place that would have been of less moment. But here in their cherished home, it was too much for these birds, so timid, and so circumspect. But have birds feelings? Who can doubt it? Doth not God care for birds? Verily, "your Heavenly Father feedeth them." What a resolution was that taken by these birds, every one of them. And how grandly prompt the performance. Fitting hour it was too for so sad an act—they left their home in the night—thus disrupting the bliss of the nuptial month by accepting a homeless uncertainty. That entire colony abandoned the spot where they and their ancestors had dwelt for fifty summers. In premature maturity one mother

bird at least had been compelled to lay her eggs, and then must leave them behind. And this pretty treasure on my table is one of them. Interesting, was it said? Nay, is it not historic, a memento of this remarkable exodus of the night herons from their almost romantic heronry at Three-mile Run, New Jersey. Do you ask, "Did they hold together as in a well-ordered retreat? And did they establish a heronry elsewhere? Or did the dispirited community dissolve itself into the isolation of single pairs? And finally, where did they go?" Well, just these are the questions which we are aching to find out. Meanwhile, let this much go on the record, of the time, circumstance, and spirit of the exodus of this ancient colony of birds.

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VARIATIONS IN THE NESTS OF THE SAME SPECIES OF BIRDS.

BY DR. T. M. BREWER.

IN the present brief paper I propose to deal more with facts than with theories. I leave to others to make such deductions therefrom as may suggest themselves. When one cannot, to his own satisfaction, point out the reasons that can fully account for indisputable facts, it seems to be the safer course to be content with only taking cognizance of natural phenomena, just as they impress our senses. The legitimate scope of the naturalist is first correctly to describe isolated facts as they present themselves. To seek to investigate the laws that unite these, though always tempting, is not always safe. The homely advice: "Never to prophesy unless you know," is applicable to the case. There is no worse bondage to the student of nature than to be a slave to theory. The danger of a "little learning" is of its leading to unwarrantable deductions, and then the temptation to color facts to suit preconceived opinions may become one of the besetting weaknesses of our human nature, against which it behooves naturalists especially to struggle manfully.

From time immemorial the theory has been prevalent, and generally accepted, that the constructions of all animals, man excepted, are the inevitable results of a faculty called instinct. On the other hand it is claimed that all the constructions made by man are due to another faculty known as reason. To this I am

not prepared to assent without many qualifications. Thus broadly stated it is entirely inconsistent with innumerable facts. The architectural achievements of very many kinds of birds, their variations and their deviations, their skill, their wonderful adaptations to varying circumstances, all point to intellectual action much higher than a mere blind instinct. The wretched holes, the degraded lives, on the other hand, of the Papuans and the Australians are surely not evidences of reason, properly so called. Their homes are infinitely below those of nearly all the feathered tribes, and show no advance. A few years ago it was discovered by accident that within fifty years there has been a wonderful change in the manner in which the common house martin of Europe builds its nest. Formerly their nests were globular in shape, with a small rounded opening, hardly large enough to admit the parent birds comfortably. Such are all the old nests in museums, such the descriptions of all writers, half a century ago. These nests were inconvenient, only one bird could come at a time to the opening to be fed. Long before the young could leave their nest, they must have been uncomfortably crowded in their ill-ventilated and close quarters. Some time within the half century this entire species has made a great advance and wonderful changes in the whole style of their nest. Instead of a sphere, the nest is simply hollow, semi-oval, roomy, airy and comfortable, stronger in its attachments, with increased facilities for access, better protected, both from the rain and from enemies. Unfortunately no one observed just when this remarkable change in their architecture took place. We know not if it was gradual or sudden, or how long it was in becoming general. But surely no one can pretend that all this was the result of mere instinct! Wallace maintains that no bird can succeed in constructing a nest in the same manner as its congeners, if it has not first learned their method, either from its own parents or from others of its kind. From this it would appear that birds brought up in confinement, from their nests, cannot construct nests like those of their fellows who have always been at liberty. Without attempting to decide how far Wallace's theory may be well founded, I can give two instances that have fallen under my own observation, that have an indirect bearing on the general need of instruction in other things than making a nest. A young cedar bird fell from its nest and was so severely injured that it never obtained the use of one wing. It was fed from the hand and remained wholly dependent on the care

of its benefactor. It never would attempt to feed itself even with food all about it, and when it was transferred to other hands died of starvation in the midst of abundance. Nearly the same occurred with a young mocking bird, who always insisted upon having its food held to its mouth. The latter died young, but the cedar bird reached maturity, and was two years old without learning to feed itself.

It is contended by some naturalists that the nests of young birds are invariably poorly made and not well situated. This, however, is a belief that it would not be very easy to verify. That birds of the same species do not always build their nests alike, that under varying circumstances they will vary their style in a very remarkable manner, is a matter of not unfrequent observation. Thus the cliff swallow, in wild tracts of country, and in its original haunts, constructs, with much labor, a long nest, shaped like an inverted retort, with the entrance from below. On Green Island, one of the Grand Menan group, I saw a large colony availing themselves of two boards put up for their convenience, and about half a foot apart, under the eaves of a barn, and all building open cup-shaped nests as unlike their typical nests as can be conceived.

In the last number of the Nuttall Bulletin, Mr. Brewster contributes a very interesting paper on the nesting of the yellow-throated warbler, *Dendræca dominica*. The nest found by Mr. Brewster was on a stout horizontal branch of a southern pine, set flatly on the limb. It was a well made—an unusually well made nest, the framework being a few twigs and strips of bark into which had been worked a beautiful soft felting of moss and silky down of plants, all neatly and firmly compacted. I have seen the nest and am inclined to the opinion that it is probably the typical style of this bird, whenever it builds in a region where the abundance of the Spanish moss does not tempt it to make use of that growth, and there to build a totally different nest, with no other framework than the long fibres of the moss afford. In the appendix of the Ornithology of North America, I refer to several nests of this bird built in this latter manner, taken by Mr. Norwood C. Giles, of Wilmington, N. C. Several of these nests were obtained and well identified, and sent with their parents to the Smithsonian. Unaware of this positive identification, Mr. Brewster very naturally infers that Mr. Giles must have been mistaken. But this was not so. His identification was complete, and only adds another re-

markable instance of variation in the mode of nest building by the same species. The history of several of our North American birds also affords abundant evidence that it is by no means safe to assume that the same species may not exhibit a "great difference in the position and structure of the nest," under varying circumstances.

The recent observations of Dr. James C. Merrill (MSS.) shows that the *Icterus cucullatus* displays quite as striking variations as this warbler. Some of its nests, like those of the latter, are buried in tangled and elaborately interwoven masses of the Spanish moss, and have no apparent resemblance to others built in the more normal pensile style of its congeners, such as the orchard oriole and others. So, too, with the nests of the *Empidonax acadicus*. The first identified nest of this species I ever saw was a flat platform, so common in *Contopus borealis*; and this is its usual style about Philadelphia. The second was a deep cup-like nest, surrounded and surmounted by a curious chevaux-de-frise, somewhat in the style of the magpie and the mocking-bird. This style is common in Indiana. And now within a few months, I have received two other nests equally well identified, one of them with the eggs, the nests being pensile and not unlike those of the orioles. Such facts as these warn us that we need not and should not, on too slight grounds, discredit either the carefulness or the truthfulness of our fellow-workers in observing the hidden and often varying facts of natural history, even when their observations do not accord with our own. The account of the nesting of the *D. dominica* given by Mr. Nuttall has always seemed in the last degree improbable, and to be in conflict with that of Mr. Audubon, and their discrepancy has long been a stumbling-block to students until more light began to be thrown upon its history. Mr. Giles' revelations gave us some clue to what seemed the fabulous narrative of Mr. Nuttall. For when we remember how closely together stand the trees in a cypress swamp, how the long "ropes" of *Tillandsia* do swing from tree to tree, we can now understand how Mr. Nuttall, having never seen it himself, may have imperfectly understood the information he received from another in his account of its swinging nest. And now Mr. Brewster confirms substantially Mr. Audubon's discredited account of his experiences. After all, these pioneers in American ornithology may not have been so absurdly inconsistent, or so entirely at fault as we, in our own ignorance, have taken for granted.

I might go on and prolong this article by other accounts of conspicuous variations made by the same species in its nest-building, citing the lammergeyer that builds indifferently a huge nest on a tall tree, or lays its eggs on the bare ground or some tall cliff, without any nest at all, but I have given enough to show how marked these variations often are. To speculate on the whys and the wherefores would be a very tempting theme were it not that we are so often at fault in attempting to explain them. But I do not believe it is logical to call the intellectual promptings that inspire these variations mere instinct, though we may not be able to read clearly the hidden motives. If experience taught the European martin that its old-fashioned nest, which perchance it had built since the flood, was inconvenient, ill-ventilated and unsafe, and they were prompted by the example of some wiser intellect among themselves to improve upon the hovels of their fathers, so that all at once the whole race made a long stride in improvement, can we call this instinct? Grant that the changes have been slow—extending over fifty years—so gradual that no one has noticed the change while it was going on, we cannot deny the advance, and advance is inconsistent with our ideas of instinct which is unchangeable and incapable of education. It is a clear case of reason and instruction, yielding marked fruits, and is on a higher plane. That birds like the *Dendræca dominica* and the *Icterus cucullatus* build a typical nest, like their congeners, where nothing tempts them to do differently, but where the long branches of *Tillandsia* offer a safe shelter and the absence of labor, shows something higher than instinct, there must be a rational intellect that prompts them to avail themselves of the opportunity.

If we cannot understand what it can be that stimulates an *Empidonax* in Staten Island to build a pensile nest, while its fellow in Indiana builds one like a deep cup and surrounded with thorns, and another group in Pennsylvania put theirs on an exposed tree-top, and so flat that the eggs seem liable to roll out, we must see that some cause, hidden to us, is gradually effecting changes that sooner or later may become universal in the species, though which it is to be we may not be able to imagine.

Our eastern song-sparrow's natural instinct prompts it to build on the ground. A series of disasters to its eggs or brood impress it with the need of a safer place. It draws nearer the friendly shelter of a dwelling, and there, no longer on the ground, but up in some thick bush or vine, it makes its nest. For want of the

tufts of grass or weeds that furnished it with a roof, it changes its whole shape and builds a bulky, nearly spherical, domed nest. Some of its offspring adopt the new style of their parents, but others fall back upon their original style. The latter may be considered the promptings of a natural innate instinct, but the domed nests, the changes initiated by the parents and imitated by the more enterprising of their offspring are due to a higher intellectual power that rejects the blind suggestions of their original instinct, and teaches them to follow the paths of experience to safety. This is no imaginary case, but rests on facts within my own observation.

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THE RELATION OF ANIMAL MOTION TO ANIMAL EVOLUTION.

BY E. D. COPE.*

THE origin of variation in animal structure is, *par excellence*, the object of the doctrine of evolution to explain. There can be little doubt that the law of natural selection includes the cause of the preservation of certain modifications of preëxistent structure, in preference to others, after they have been brought into existence. In what manner or by what process the growing tissues of young animals have been so affected as to produce some organ or part of an organ which the parent did or does not possess, must be explained by a different set of laws. These have been termed *originative*, while those involved in natural selection are *restrictive* only.

I.

Of course we naturally look to something in the "surrounding circumstances" in which a plant or animal is placed, or its "environment," as the most probable stimulant of change of its character, because we know that such beings are totally dependent on cosmic and terrestrial forces for their sustenance and preservation. The difficulty has been to connect these forces with change of structure as *originative*; to show their operation as multiplying, restricting or destroying organisms already in existence is comparatively easy. This difficulty is partially due

*Abstract of a paper read before the American Association for the Advancement of Science, at Nashville, August, 1877.

to the fact that such modifications must be realized during a limited portion of the life of an animal at least; that is, during the period of growth, when it is not at all or but little subject to the influence of external environment, but is usually protected or supported by the parent.

That the environment and changes in it affect the movements of plants and animals is clear enough. The potency of such changes may be read in the physical history of the earth. A long series of modifications preceded the advent of life upon it, and change, both gradual and sudden, has been exhibited in the configuration and climate of all portions of the surface of the globe since that period. Animals have again and again been called upon to face new conditions, and myriads of species have fallen victims to the inflexibility of their organization which has prevented adaptation to new surroundings. But it is evident that if change of environment has had any influence in the progress of evolution, it has not been alone destructive. It has preceded life as well as death, and has furnished the stimulus to beings capable of change, while it has destroyed those which were incapable of it. It is a truism that change of physical conditions has preceded all great faunal changes, and that the necessity for new mechanism on the part of animals has always preceded the appearance of new structure in geologic times.

The embryology and palæontology of vertebrated animals show that the primary steps in the progress of this branch of the animal kingdom are marked by the successive changes in the structure of the circulatory system. First we have the various mechanical methods for the aëration of blood in a watery medium; the result being a fluid whose metamorphosis in nutrition produces no heat. After the fishes followed *Batrachia*, the earliest air-breathers, whose long tarriance to-day in early aquatic stages, is an epitome of the necessarily "amphibious" character of air-breathing vertebrate life, when land and fresh water, in constantly changing areas, were rising and separating from the universal ocean. The successive disappearance of the traces of the fish type of circulation in *Batrachia* and reptiles, are familiar facts; and the exclusion of the unaërated blood from the systemic circulation in the birds and mammals marks the increase of general temperature which gives those classes one of their claims to superiority.

The appearance of land of course furnished the opportunity

for aquatic animals to assume a terrestrial life. Marine animals which had acquired the habit of gulping air from the surface, which some of them now possess, perhaps because its richness in oxygen produced an agreeable exaltation or intoxication, would not find visits to the land difficult. And this would naturally follow the necessity of escape from aquatic enemies, or the search for new supplies of food.

In fine, it requires little argument to show that the environment has had in the past as in the present, a primary influence over the movements of animals.

II.

I will now endeavor to exhibit some reasons for believing that the movements of animals affect their structure *directly*.

There are two alternative propositions expressive of the relations of the structures of animals to their uses. Either the use or attempt to use preceded the adaptive structure, or else the structure preceded and gave origin to the use. The third alternative, that use and structure came into being independently of each other is too improbable for consideration in the present article. Many facts render the first of these propositions much the more probable of the two.

A general ground for suspecting that movement affects structure is the fact well known to systematic zoölogists, that adaptive characters are the least reliable in systematic classification, *i. e.*, are the most variable. What we call adaptive characters are those whose teleological significance we can most easily perceive; those whose uses are at the present time most obvious. Systematists habitually fall back on characters which are apparently the least related to the ordinary necessities of the life of the animal, and this not from any theoretical considerations, but because such characters are found to be the most constant; this is a very significant fact, showing as it does that it is the adaptive structures which are undergoing modification to-day. And this truth can doubtless be discerned in all past ages, for many of the structures which are not now more related to the needs of an animal than many others might be, were at one time most essential to its well-being, or necessarily related to its environment. Such are the structural characters of the heart and arteries already enumerated. There seems to be no reason why all *Vertebrata* might not exist with equal comfort and success at the present if possessed of a

uniform organization in this respect. But the successive modifications which they present were, in past ages, most intimately connected with the progressive changes of the medium in which they lived, as to the volume of oxygen supplied for respiration, as compared with that of the vapor of water, carbonic acid gas, etc. But it must be here noted, in passing, that there are many structures in animals which have never been adaptive, but which are simply due to excess or defect of nutrition following a redistribution of force.[1]

The most direct evidence in support of the view that motion affects structure directly, is to be found in the well-known phenomenon of the increase of the size and power of all organs by use. This increase is limited in the adult animal by the general fixity of all the organs, so that one of them cannot be developed beyond a certain point without injury to others, or without exhausting the source of supply of nutritive material or special force derived from other organs. The syncope of the gymnast is an illustration of the natural limitation to the development of the muscular system which proceeds at the expense of the digestive and circulatory. But effort and exertion may become a habit of mind, which even if limited in its executive means, is probably inherited by offspring like all other mental traits. Such a quality possessed by an infant or child doubtless tells on the growth of its organs during their plastic stage, and produces structure by growth which is impossible to the mature body.[2] And no one knows as yet how far mental bias, may affect the nutrition of the parts of the infant in utero. Certain it is, that if use modifies nutrition in the adult, it must have still greater influence in the young; and it is in the young that the changes which constitute evolution necessarily appear.

Change of structure during growth is accomplished either by addition of parts ("acceleration") or by subtraction of parts ("retardation").

Acceleration is produced either by multiplication of parts (as cells or segments) already present ("homotopy"), or by the transfer of parts (cells) from one part of the organism to the other ("heterotopy"). Homotopy or repetition is the usual and normal mode of acceleration; it may proceed by an "exact repetition" of the parts already existing as in the simplest animals and

[1] Method of Creation, 1871, p. 23.

[2] In man these changes are chiefly produced in the brain.

plants; or the new parts may differ from the old, as in higher animals, where the process is called "modified repetition." Where new forms traverse in their growth all the stages in which they previously existed, they necessarily present at each stage the characters of those forms which have remained stationary in them, and have not changed. This relation of "exact parallelism" is the result of the simplest form of evolution or "palingenesis." When the history of growth of an advanced form does not show an identity between its stages and the various undeveloped or lower adult types, the relation is termed "inexact parallelism," and the type of development "cœnogenesis."

Change of structure is seen to take place in accordance with the mechanical effect of three forms of motion, viz: by *friction*, *pressure* and *strain*. Under the first two, epidermal tissues become both dense and thick, as is seen on the palms and soles of the hands and feet and in corns. There is no doubt that strength of the teeth is intimately connected with the hardness of the food. Density of osseous tissue and the coössification of parts of the skeleton, are directly associated with the force and duration of muscular contraction. Pathology abounds in illustrations of the determination of nutrition to new localities to meet the exigencies and demands arising from new stimuli. It is only necessary for a structure-producing supply of nutritive material to be habitually determined to a new locality by oft recurring stimulus, for the movement to become automatic and reflex; and such a tendency would sooner or later be inherited, and produce structure in the growing organism of the young to a degree far exceeding anything that is possible in the adult.

In view of the above considerations, we can ascribe an extensive class of osseous projections at points of muscular insertion, to the strength and duration of muscular contractions. To the same cause may be ascribed various anchyloses, such for instance, as is seen in the foot of the sloth. Transverse strains or their absence may be looked upon respectively as the cause of the hinge-like or immoveable articulations of the segments of the limbs of vertebrate animals. It is well known that in land animals, where easy flexibility of the limbs is essential to speed, that these articulations are highly developed, while in marine animals where the limbs are only used as paddles, they are almost or quite inflexible, and the extremities of the bones are truncate. In the most highly organized land mammalia, the tibio-tarsal, and humero-cubital

articulations display an interlocking or tongue and groove character. The same thing is seen in the ulno-radial fixed articulation in the same types. These arrangements are especially adapted to prevent dislocation by side strains, and if the preceding explanations be true, this structure is a corrugation due to the lateral pressure of a more or less convex surface, on a concave one which embraces it, and vice versa.

In the circulatory system pressure has doubtless played an important part. Increased oxygenation of blood, the necessary consequence of the purification of the atmosphere, would stimulate the action of all the organs, including that of the heart. Greater pressure on its walls and septa would increase their size and strength, and ultimately close such foramina as were not in the course of the blood current; as the *foramen septi ventriculorum* of reptiles and the *f. ovale*. Increased force of the current would, on the other hand, soon cause the enlargement of one or other of the four or five pairs of primary aorta bows, and develop it at the expense of the others, until finally the pre-eminence of one channel be secured and the aorta be the result. This part of the subject might be prolonged to an unlimited extent, but the above illustrations must suffice to indicate the meaning of my propositions.

III.

That movements change the environment of a plant or an animal, or parts of them, is obvious enough. If we consider only the reflex class, to which all the movements of plants and many of those of animals belong, we perceive that but for them the ordinary functions of assimilation, circulation, etc., could not be performed; there would be no change in the contents of their tubes and cells, and the environment of these would be unaltered. But when we view the movements of the higher animals, we perceive the immense importance of the powers and organs of movement as a factor in evolution. It may be safely assumed, that without powers of designed or adaptive movement, life would never have advanced beyond the stage presented by the vegetable kingdom.

The stimuli which are effective in animal consciousness are four, viz: excessive temperature, hunger, danger from enemies, and the reproductive instinct. These prompt to the movements which we observe in animals in a wild state, and without which it is evident that the animals themselves would soon cease to exist.

It cannot be denied that organisms which are incapable of moving from place to place in search of food, or of migration to escape vicissitudes of temperature, are much more completely subject to the influences of their environment, than those that are capable of such movement. Hence animals are much more independent of the supply of food and of temperature than are plants. Hence also, other things being equal, the greater the powers of motion, the greater the independence.

Powers of movement then enable animals to avoid extremes of climate by migrations or by protective arts. They enable them to procure food by making journeys in search of it, and by all methods of capturing it. They furnish the agent of active defence against enemies, and of successfully reproducing their kind.

When, through changes of level of the earth's surface, drought has overtaken a region, animals capable of the necessary migrations have escaped. When an irruption of destructive animal enemies has threatened an animal population with death, those members of it whose strength or speed ensured them safety, were the survivors. When land has been encroached upon by water to such a degree as to bring starvation on its animal inhabitants, those which could fly or swim have sought new localities.

Since all food supply, as well as the ability to obtain food, is dependent on temperature, those portions of the organism which furnish means of resistence to climatic vicissitudes have the deepest significance in the life history of any division of animals.

The organs of circulation and motion are generally recognized as primary in the classification of *Vertebrata.* All situations where animal life is permitted by climate, support vegetable life also; so each of the primary divisions of animals presents types adapted to the use of all kinds of food; herbivorous, omnivorous, and carnivorous. Accordingly it has been found that dental and other structures connected with digestion, define divisions of secondary value and minor extent. Paleontology shows that the origin of such divisions is of later date than that of the great classes first mentioned; and each of the latter has in its day been modified in the subordinate directions indicated by the teeth and beak. But here also organs of movement are of great importance; so that the herbivorous and carnivorous types at least, have ever in land animals (reptiles, birds and mammals) been characterized by the structure of their feet also.

IV.

It has been maintained above, that environment governs the movements of animals, and that the movements of animals then alter their environment. It has also been maintained that the movements of animals have modified their structure so as to render them more or less independent of their environment. The history of animal life, is in fact that of a succession of conquests over the restraints imposed by physical surroundings. Man has attained to a wonderful degree of emancipation from the iron bonds that confine the lower organisms.

It becomes then all important to examine into the elements involved in animal movements.

These are of the two classes, reflex and conscious. To the former, belongs the accelerated activity of muscular action and circulation, inferred to have accompanied increase in the percentage of oxygen in the atmosphere, during the earlier periods of geological time. To the consciously performed acts belong all those due to states of pain or pleasure in animals; such as are excited by the four classes of stimuli already mentioned.

Doubtless physical changes in the surrounding medium have always produced new reflex movements in animals, and have been a first element in evolution. Such has been the immediate cause of change of structure in plants, and in animals so far as they are unconscious. But consciousness brings with it limitless possibilities, since it places an animal in contact with innumerable stimuli, which leave unconscious beings unaffected. All the causes which provoke the movements of higher animals are appeals to consciousness, and the consequences due to movements of such beings have only been possible through consciousness.

It is evident then that sensibility to impressions has been the prime essential to the acquisition of new movements, and hence of new structure, other things being equal. Another essential, not less important, has been memory; because without this faculty, experience, and hence education and the acquisition of habits of movement, are not possible.

The ascending development of the bodily structure in higher animals has thus been, in all probability, a concomitant of the evolution of mind, and the progress of the one has been dependent in an alternating way on the progress of the other. The development of mind has secured to animals the greatest degree of independence of their environment of which they are capable.

The first important acquisition leading to this end was aërial respiration; the second, rapid nutrition by hot blood. And as essential to the production and preservation of these, improvements in organs of movement have been superadded to every successive type of life.

Consciousness remains as the unresolvable factor in the process; as at once the measure of, and respondent to a large class of phenomena.

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RECENT LITERATURE.

COOK'S BIOLOGY.[1]—It appears that the author of this book, after finishing his theological studies, exhausted the study of biology in the course of a summer's vacation by lying on his back on "Bioplast Beach," reading Beale on the Microscope and some of the popular books of Huxley and Haeckel on the Darwinian question. This may be an excellent way to get up a course of sensational lectures for an audience of clergymen and others who wish to be amused after their Sunday toil, but until we have some evidence that the author personally made the acquaintance of the weeds, snails, and other creatures living about this romantic Bioplast Beach, and spent a number of years studying their structure, development, and classification, we fear that the book must be set down as a burlesque on biology. The title, even, is misleading. The book should more properly be dubbed Romance of Natural Theology. No naturalist will want to waste time over it, and the lay as well as the clerical reader should look with no little suspicion upon the distorted science and sensational statements scattered through its pages. The Preludes are much better to our mind than the Biology.

VAUGHAN'S OSTEOLOGY AND MYOLOGY OF THE DOMESTIC FOWL.[2]—An account of the skeleton and muscles of the common fowl, such as this, will prove of much use to one beginning the study of anatomy. This book is well prepared and fully illustrated, and will be of service in the laboratory.

THE GEOLOGICAL RECORD FOR 1875.[3]—This volume is of the same nature as the one issued last year, though it is larger, improved in its plan, and contains an index of new species, which will add to its value in the eye of the palæontologist. As the

[1] *Biology: with Preludes on Current Events.* By JOSEPH COOK. Boston: James R. Osgood & Co. 12mo, pp. 325.

[2] *Notes on the Osteology and Myology of the Domestic Fowl* (*Gallus domesticus*). By VICTOR C. VAUGHAN, Ph. D. Sheehan & Co., Ann Arbor, Mich. 1876. 12mo, pp. 116. $1.50.

[3] *The Geological Record for* 1875. An Account of Works on Geology, Mineralogy and Palæontology, published during the year. Edited by WILLIAM WHITAKER. London: Taylor and Francis. 1877. 8vo, pp. 443.

American literature in the departments of which it treats is given in the same careful, detailed way as the European, our mineralogists, geologists, and palæontologists will find in it the only annual digest of discoveries and of new works to be had in the language; and it is for their interest, perhaps, to patronize the undertaking of the editor. It is partly supported by a grant from the British Association, but still needs a larger list of subscribers for its maintenance.

WINCHELL'S RECONCILIATION OF SCIENCE AND RELIGION.[1]—While there may be an occasional antagonism between scientists and theologians, due mainly, perhaps, to mutual ignorance of each other's aims and to quite different methods of study, few will admit that science and religion are at variance, for one is based upon the other. Superstition is based on ignorance. The greater our advance in science the more will crude dogmas and superstitions be eliminated from our religious conceptions. Science is only another name for human knowledge. Morality and religion rest on a scientific foundation, namely, a thorough knowledge of the laws of health, of physiology, and of psychology. The truly scientific mind has above all things a reverence for truth, and pursues knowledge for its own sake, regardless of consequences to preconceived notions or dogmas. Such a spirit will in the end serve only to strengthen the foundations of a pure morality and a true religion.

The essays are by an expert in geology, and a theologian as well, and therefore the volume is an authoritative one on this absorbing theme.

JOHNSON'S CYCLOPÆDIA.[2]—The fourth volume of this compact and useful cyclopædia well compares with the three that have preceded it, and the work as it now stands, from a scientific point of view at least, is quite as fresh and timely as could be desired. While the literary and biographical articles are excellent, especial stress has, as may be imagined from the names of the editors, been given to physical and natural science. Most of the zoölogical articles in the present volume have been contributed by Prof. Theodore Gill, though a lengthy and well illustrated article on sponges is contributed by Prof. Hyatt. Botanical articles by Profs. Gray, Goodale and Farlow, geological articles by Prof. Newberry, and palæontological articles by Prof. O. C. Marsh, attest the freshness and accuracy of the contributions, and the judgment shown by the editors in selecting the leading specialists of the country as collaborators.

[1] *Reconciliation of Science and Religion.* By ALEXANDER WINCHELL, LL.D. New York: Harper & Brothers. 1877. 12mo, pp. 403.

[2] Johnson's New Universal Cyclopædia: a scientific and popular treasury of useful knowledge. Illustrated with Maps, Plans and Engravings. Editors-in-chief, F. A. P. Barnard and Arnold Guyot. Complete in 4 vols. Vol. IV., 1878. A. J. Johnson & Son, New York. 8° pp. 1760.

RECENT BOOKS AND PAMPHLETS.—The Geological Record for 1875. An Account of Works on Geology, Mineralogy, and Palæontology published during the year. Edited by William Whitaker. London: Taylor & Francis. 1877, 8vo., pp. 443.

The different Forms of Flowers on Plants of the same Species. By Charles Darwin. With Illustrations. New York, D. Appleton & Co. 12 mo., pp. 352.

Pollen. By M. Pakenham Edgeworth. Illustrated with 438 figures. London. Hardwicke and Bogue, 192 Piccadilly. 1877. 8vo, pp. 92.

Notes on the Structure of Several Forms of Land Planarians, with a Description of Two New Genera and Several New Species, and a List of all Species at present known. By H. N. Mosely. 8vo, pp. 21. (From Quarterly Journal of Microscopical Science.)

On Stylochus pelagicus, a New Species of Pelagic Planarian, with Notes on other Pelagic Species, on the Larval Forms of Thysanzoön, and of a Gymnosomatous Pteropod. By H. N. Mosely. 8vo, pp. 11. (From Quarterly Journal of Microscopical Science.)

Catalogus Plantarum in Nova Cæsarea Repertarum. Catalogue of Plants growing without Cultivation in the State of New Jersey, etc. By Oliver R. Willis. Revised and enlarged edition. A. S. Barnes & Co., New York, Chicago, and New Orleans. 8vo, pp. 88.

Practical Directions for Collecting, Preserving, Transporting, Preparing, and Mounting Diatoms. By Professors A. M. Edwards, Christopher Johnston, H. L. Smith. New York: The Industrial Publication Co. 1877. 12mo, pp. 53.

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Das Variiren der grösse gefärbter Blüthenhüllen und seine Wirkung auf die Naturzüchtung der Blumen. Von Dr. Herman Müller. (From Kosmos.) 8vo, pp. 14.

Glacial or Ice Deposits in Boone County, Kentucky, of two Distinct and Widely Distant Periods. By George Sutton. (From the Proceedings of the American Association for the Advancement of Science, Buffalo Meeting of 1876.) 8vo, pp. 5.

The Latimer Collection of Antiquities from Porto Rico in the National Museum at Washington, D. C. By Otis T. Mason. (From the Smithsonian Report for 1876.) Washington. 1877. 8vo, pp. 23.

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A New Order of Extinct Reptilia (*Stegosauria*) from the Jurassic of the Rocky Mountains. By Prof. O. C. Marsh. (Appendix to the American Journal of Science and Arts. Dec., 1877. pp. 1.) New Haven.

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GENERAL NOTES.

BOTANY.

NOTES ON THE ALPINE FLORA OF MT. SHASTA.—While looking for insects on the crater cone of Mt. Shasta, in Northern California, late in August, I hastily picked up examples of all the plants I could find at and above timber line, and at the lower edge of the limits of perpetual snow, which is said on this peak to be about 9000 feet above the sea. I was struck, though not a botanist, with the radical difference between the alpine (?) flora of Mt. Shasta and that of the Rocky Mountains and the White Mountains and the Alps of Switzerland. In the case of Mt. Shasta, which forms the northern terminus of the Sierra Nevada, the flora seemed much less alpine in its nature than was expected, and appeared to have been of local derivation from the foothills and plains below. I am indebted to Mr. Sereno Watson for naming the phænogams, to Prof. W. G. Farlow, for identifying the lichens, while Mr. Booth kindly named the Carex. No distinctive alpine insects occurred, only a wingless locust, which was also found lower down among the firs.—*A. S. Packard, Jr.*

Phænogams — *Silene grayi* Watson (ized.) (in flower); *Saxifraga tolmiei* T. & G. (in flower); *Applopappus bloomeri* Gray (in flower); *Senecio aureus* var. *borealis* (in flower); *Penstemon mensiesii* Hook (in flower); *Penstemon mensiesii* var. *douglasii* (in flower); *Elymus sitanion* Schult (in flower); *Polygonum shastense* Brewer (in flower); *Lupinus ornatus* Dougl. (in flower); *Bryanthus empitriformis* Gray; *Phlox douglasii* Hook. (in flower); *Erigonium morifolium* T. & G. (reduced form, in flower); *Erigonium pyrolæfolium* Hk. (in flower); *Ceanothus prostratus* Benth.; *Sedum glandulosum* Nutt; *Polymonium humile* Willd; *Gilia pungens* Benth. (in flower); *Hulsea nana* Gray (in flower); *Pinus albicaulis.*

Carex—breweri Booth.

Lichens—*Lecanora chlorophana, Lecanora rubina* var. *opaca? Lecanora glaucoma? Umbilicaria rugifera* Nyl.,

PRODUCTION OF APPLES IN "OFF" YEARS.—We have been informed by Mr. Elbridge Gerry, of Marblehead, Mass., that some twenty-five years ago the foreman of the Pickman Farm, in Salem, raised crops of apples in the "off" year, *i. e.*, the year they usually

did not bear, by simply picking off the fruit buds in the bearing years. His neighbors could never understand how he was enabled to raise a fair crop each year, until finally the secret became known. This mode of artificial selection is quite new to us, and we would like to know if it has ever been practiced before in orchards.

In connection with this subject I am told by Mr. John Sears, of Danvers, Mass., that in old orchards deep ploughing, by which the roots are often torn and broken, carried on in the "even" years, will cause the young apples to fall off, so that they will bear the next year. Also picking off the apples on the young trees in the "even" years will cause the trees to produce in the "off" years. Still, adds Mr. Sears, none of these processes are perfectly sure.—*A. S. Packard, Jr.*

Botanical News.—The following articles appear in the *Annales des Sciences Naturelles*, for September 1877. J. Vesque, on the absorption of water by roots in its relation to transpiration. Sorokine, On the structure of *Crocysporium torulosum* (a microscopic fungus). J. Wiesner, Researches in regard to the influence of light and radiant heat upon transpiration in plants. Dehéran, A notice of the preceding memoir. Van Tighem, On the digestion of albumen. Fischer de Waldheim, On *Ustilagineæ* and their hosts.

Flora, No. 23, contains the following papers: W. Nylander, Remarks concerning gonidia and their different forms; No. 24, A. Wigand, On horn-prosenchyma; No. 25, Hugo de Vries, Concerning longitudinal epinastic (elongation of the internal surface of an organ); F. Arnold, The Musci of the French Jura; No. 26, Dr. H. Christ, Roses observed in 1876, de Thümen, South African Fungi; No. 27, Schulzer, Concerning certain Fungi; No. 28, Robert Caspary, Life of Alexander Braun.

Botanische Zeitung, No. 39, Dr. O. Drude, Selected examples to explain the formation of fruit in *Palmeæ* (continued and illustrated by plates in No. 40); No. 40, Prof. J. Baranetsky, On diurnal periodicity in the growth of internodes in length; Oudemans, Notices respecting certain Boleti. Many critical notes by the editors conclude the number. No. 41, Rostafinski and Woronin, On *Botrydium granulatum* (continued in No. 42). No. 42, Dr. Karl Goebel, History of the development of the Prothallium of *Gymnogramme leptophylla*, Desv.

A Botanical Section of the Peabody Academy of Science, Salem, consisting of about twenty members living in Salem and adjoining towns, has lately been formed there, bi-monthly meetings having been held. Dr. G. A. Perkins is Chairman, and Miss L. H. Upton, Secretary.

The nature of the Spermatia is discussed by G. Murray, in Trimen's *Journal of Botany*, for October.

The Nuovo Giornale Botanico Italiano, for October, contains a paper by O. Beccari, describing a new genus of the family Olacineæ; and the editor, T. Caruel, proposes a new classification of plants, the reasons for which are to be given in an unpublished work on vegetable morphology. The transactions of the Royal Swedish Academy for 1874 and 1875 (just received in this country), contains papers by Heer, on the miocene flora of Greenland; by Berggren, on the mosses and Hepaticæ of Spitzbergen, and also on the mosses of Disco Island, Greenland.

ZOÖLOGY.

NOTE ON THE GARTER SNAKE.—While making some geological examinations on the bank of Lone Tree Creek in Colorado last summer, I started a common snake (*Eutænia*, sp.) upon the bank. It immediately took to the water, which was then about eighteen inches deep and had but little current, rested upon the surface and looked at me. I threw a stone which struck near it, when it immediately stretched itself upon the surface, gulped down into its lung a quantity of air, and immediately dived to the bottom and remained there. The mass of air it swallowed caused a distinct globular swelling of the body, which I saw pass along to the region occupied by the posterior end of the lung, where it remained, as I could distinctly see through the clear water, after it had reached the bottom. I then threw a broad, flat stone so that it fell upon the snake and held it fast, whereupon two or three large bubbles of air rose to the surface. I then lifted the stone from it with a stick, allowing it to escape, and as it did so I saw that the air-swelling had disappeared.

I infer that this is probably a habit with the snakes under such circumstances, but I was not aware of it before. In this case the air seems to have been intentionally passed back to the posterior, simple sac-like portion of the lung, where respiratory capillaries are few, to be passed forward to the more cellular anterior portion when the respiratory needs might require it.

The cellular character of the anterior portion of the lung would seem to have offered some impediment to the rapid swallowing of so much air, but I am sure it was so done in this case.—C. A. WHITE, M. D.

NESTING OF THE ROBIN ON THE GROUND.—An instance of this deviation from the usual conditions of nest-building came to my knowledge in May, 1875, near Vineland, New Jersey, where I found a nest of *Turdus migratorius* on the ground. It contained four eggs, and was not peculiar in structure. The nest was identified, as one of the old birds flew from it on my approach. I also saw a stump about a foot and a half high, on which I was informed that a pair of robins had nested.—H. W. TURNER, Ithaca, New York.

WILD GEESE NESTING IN TREES.—While in Greeley, Colorado, last summer, Mr. Louis Wyatt told me that he had seen wild geese nesting in large cottonwood trees on Snake River, a branch of the Yampah or Bear River, west of the Rocky Mountain range, in Colorado, at a point bearing a little north of west of Greeley, Colorado. This is the only instance published, I believe, of this habit as observed in Colorado. Dr. Coues, in his "Birds of the Northwest," states that it "nests in various parts of the Upper Missouri and Yellowstone regions *in trees*."—*A. S. Packard, Jr.*

RATE OF GROWTH OF THE BARNACLE.—Upon taking up, Nov. 17, a post to which my boat was moored, and which was put down at low-water mark April 5th, 1877, in Salem harbor, I found numerous barnacles (*Balanus balanoides*) living and of nearly full size, being four-tenths of an inch in diameter and about two-tenths high. With them were small *Fucus vesiculosus*, the largest one of which was about three inches in length. The post was a new one and had not been used the year previous. A number of similar observations will be found in Darwin's work on barnacles.—*A. S. Packard, Jr.*

ANTHROPOLOGY.

THE ARCHÆOLOGY OF THE PACIFIC COAST.—The Rev. Stephen Bowers has just completed an archæological exploration along the Pacific Slope for Major J. W. Powell, who is in charge of the Survey of the Rocky Mountain Region. During the six months of his labors, Mr. Bowers examined one hundred and fifty miles of the southern coast of California, and the inland country drained by the three streams, Santa Iñez River, Sisquoc River, and Cuyama River. He also visited San Miguel and Santa Cruz Islands, having previously explored Santa Rosa Island for the Smithsonian Institution. The results of his last and most important expedition are between five and six tons of antiquities.

The collections obtained consist of the following objects: Ollas of crystalized talc; *tortilla* or millstones of the same material; arrow-smoothers of the same material; mortars and pestles of sandstone (some of the latter finely wrought and over two feet in length); cups of serpentine; pipes of indurated talc and other material; charms or amulets of talc, etc.; perforated discs of serpentine, sandstone, etc.; spear-points and arrow-heads; knives of chert; vast quantities of shell ornaments, and beads, in great variety; stone tubes, etc.

The perforated discs or "stone rings or doughnuts" Mr. Paul Schumacher believed to have been employed to give weight to the wooden spades with which the ancient pits or graves were dug. This attempt to designate their use is as clever as his inference is improbable. The rings are usually so light in weight as to be of no value in this respect, and in order to be serviceable as weights they would be too bulky for use. They weigh from a few ounces

to several pounds. A more plausible explanation of their use is the one Mr. Bowers advances: he says, "Those of pyramidal form were doubtless used in spinning, while others were used in games." —E. A. Barber.

Anthropological News.—It has been impossible to obtain a programme of the German Scientific Association, but reports of two very interesting communications have reached us. Professor Haeckel's address on the evolution theory of the present day in its relation to science in general was an earnest reiteration of his theory of inheritance and adaptation, applying it to moral and mental phenomena. Professor Virchow read a paper On the Liberty of Science in Modern Thought. He congratulated his fellow workers that science had now obtained perfect liberty, and at the same time warned them not to lose their influence by misusing it. He advocated the introduction of scientific instruction into the schools, but thought that great care should be used to introduce the results of science, and not mere unsubstantial theories such as the genealogical system of Professor Haeckel.

The second international congress of Américanistes was held at Luxemburg, September 10th–13th. Papers on the mound builders and Pueblos were read by Messrs Barber, Robertson, Gillman, Peet, and Force; on the antiquities of Greenland and the primitive habitat of the Eskimo by Messrs. Waldemar Schmidt and Rink; on hieroglyphics and ancient culture, by Leon de Rosny, Hyde Clarke, Maladier de Montjau, Allen Schwab, Malte-Brun, Ttronck, Abbé Pipart, Dr. Leemans, etc.; on philology, by Messrs. Henry, Moore and Lucien Adams; on history, by Messrs. Brauvoisn and Nadal; on the stone age, by M. Guimet. The next congress will be held in Brussels in 1879.

Occasionally papers of great value to anthropologists appear in journals not wholly devoted to their science. Among these *La Révue Scientifique* is to be specially mentioned. In the number for January 13, 1877, M. Jouan writes upon Les Monuments polynesiens; in that for February 3d, M. Quatrefages has a long paper reviewing that portion of his late work, L'Espèce humaine, which refers to fossil man. The whole work in favorably noticed in the number for March 4th, by M. W. Ferrier. In the numbers for May 5th and 12th, Carl Vogt discusses at length the origin of man. The learned author takes issue with both Haeckel and Quatrefages, and, while advocating evolution, maintains that the former has erred quite as far in knowing too much as the latter has in his "Je ne sais pas rien." The same periodical for September contains quite full reports of the French Association.

Two fields of anthropological research are so fully occupied at the present time that one almost despairs of keeping the run of titles even. We refer to the seat of war and British India. Happily the latter field is well worked in Trübner's last catalogue, to which all must refer who would become familiar with the subject. The work of D. Mackensie Wallace on Russia, of W. R. London

on Savage and Civilized Russia, and of Russell on Russian Wars with Turkey cannot be omitted from the list of those who wish to read up on the seat of war.

The Tenth Report of the Peabody Museum is one of the most interesting in the series. We have already referred to Dr. Abbott's paper. Those of Professor Andrews and Admiral F. Bandelier are worthy of careful study.

Two articles have appeared in the New York *Nation* concerning the Nes Percés in the numbers for July 12th and August 2d. The same journal, September 6th, treats of the Indian policy of Canada and of the United States.

The archæological section of the Academy of Sciences at St. Louis, has published a caution to collectors against imitations of pottery, etc., from the mounds. The same difficulty has arisen in England and Germany with reference to antiquities within their own borders and from the East: notably, Flint Jack, the Shapira collection of Moabite pottery, and the carvings from the Thurigen Cave, near Schaffhausen in Switzerland. Colonel Whittlesey has done good service in exposing frauds in hieroglyphics, and Mr. J. D. Moody of Mendola, Illinois, sends a pamphlet of four pages, attacking the authenticity of the Rockford Tablet. No one should be more zealous than the archæologists themselves in unearthing everything of the kind, since no amount of doubtful material will aid the truth in the least.—O. T. Mason, Washington, D. C.

GEOLOGY AND PALÆONTOLOGY.

The Saurians of the Dakota Epoch.—Professor Cope has recently described two additional species of terrestrial saurians from the Dakota rocks of Colorado, which rival the *Camarasaurus supremus* in dimensions. They are referred to a new genus which resembles *Camarasaurus* in the chambered character of the vertebral centra, and in the peculiar interlocking articulation of the neural arches, but differ from it in the amphicœlous character of the centra and the form of the neural spine, which is longitudinal instead of transverse. The articulation of the neural arches alluded to is very peculiar, and is effected by the presence of a new vertebral element which Professor Cope calls a hyposphen. It is an inverted wedge which is attached to the posterior zygapophyses below them by a median vertical plate of bone. This plate enters a deep fissure between the anterior zygapophyses and it results that the latter are tightly embraced between the posterior zygapophyses above, and the hyposphen below. This structure is the reverse of that of the zygosphen articulation.

The new genus is called *Amphicœlias*, and the species *A. altus* and *A. latus*. The length of the femur of the former is six feet two inches, a little exceeding that of the *Camarasaurus supremus*, but it is more slender. The elevation of a dorsal vertebra is three feet two inches. The *A. latus* is characterized by robustness, as the *A. altus* is by elongation of parts. A caudal vertebral cen-

trum is ten inches in transverse diameter; with others it is more depressed and more deeply bi-concave than the corresponding vertebra of *C. supremus*. The femur of this species is very thick, its length is fifty inches and the diameter fourteen inches.

Additional remains of *Camarasaurus supremus* include a femur six feet, and a scapula five and a half feet in length. The posterior dorsal vertebræ exceed in dimensions those of any known saurian, equaling those of the right whale. The centra measure sixteen inches in transverse diameter.

Mount Lebanon Fishes in Dakota.—Many years ago Dr. Hayden obtained some fossil fishes from the Cretaceous No. 3 of Dakota. They have been recently examined by Professor Cope, who describes them in the late number of the Bulletin of the United States Geological Survey of the Territories. He refers them to the genera *Triænaspis* g. n., *Leptotrachelus* Mark, *Ichthyotringa* g. n., *Spaniodon* Pict., and *Sardinius* Mark. The first, second and third genera belong to the *Dercetidæ*, and *Leptotrachelus* has been found in Syria and Westphalia. *Ichthyotringa* is allied to *Dercetis* of Westphalia, and *Triænaspis* to *Pelagorhynchus* of the same region. *Spaniodon* is a well-known Lebanon type and *Sardinius* is abundant in Westphalia. This determination adds evidence to that already in our possession, showing the wide distribution of types in the Northern Hemisphere during past time.

Cretaceous Fishes of England.—E. Tully Newton of the British Geological Survey, has recently discovered the Kansas genera *Portheus* and *Ichthyodectes* in the chalk of Kent, and finds several species of both.

Clepsydrops in Texas. — Professor Cope has recently obtained this genus from the so-called Triassic formation of Texas. This discovery confirms the reference of the *Clepsydrops* shales of Illinois to that formation or the Permian, in opposition to the view at first maintained by Professor Bradley that they are a member of the coal measures.

The Genus Tetraconodon.—Dr. R. Lydekker has recently described the dentition of this genus, which was discovered by Falconer in the Sivalik formation of India. He regards it as a bunodont Artiodactyle allied in some degree to *Hippopotamus*. He finds it to be very peculiar in that the premolar teeth are of relatively enormous size, although simple in their form. The characters of the genus resemble those of *Elotherium*.

The Affinities of the Dinosauria.—Professor Owen recently described an interesting Dinosaurian under the name of *Omosaurus armatus*. At the close of the article he makes some remarks on the structural relationships of the order. He thinks that the pubic bone is directed forwards, not backwards, as asserted by Huxley. The bird-like structure of the tibio-tarsal articulation,

first pointed out by Cope, he attempts to explain in another way. He regards the supposed astragalus of *Lælaps* and *Pœciloplenron* as homologous with the tibial epiphysis of *Mammalia*, rather than with the astragalus, and he homologizes the distal tarsal element of *Dinosauria* with the mammalian diaphysis rather than with the second tarsal series.

Professor Owen has recently described an English species of *Lælaps* under the name of *Pœciloplenron minor.*

TRIASSIC SAURIANS FROM PENNSYLVANIA.—Additional material received from Charles M. Wheatley, of Phœnixville, embraces some species of extinct reptiles from the Trias of Pennsylvania not included in the last report. (See Proceedings of the American Philosophical Society, 1877, p. 182.) These are of especial interest as introducing to American palæontological science two genera only known heretofore from the European Trias, viz: *Thecodontosaurus* and *Palæosaurus* of Riley and Stuchbury. These are called *T. gibbidens* and *P. fraserianus.* A third new species belongs to the genus *Suchoprion*, and is described as *S. sulcidens.* Mr. Wheatley has also obtained additional specimens of *Suchoprion cyphodon*, *Belodon priscus*, *Palæoctonus appalachianus*, and *Clepsysaurus wheatleianus.* Teeth of the last-named saurian indicate a larger animal than the type, and nearly equal to the *Palæoctonus appalachianus.*

NEW ARTIODACTYLES OF THE UPPER TERTIARY.—Three new genera allied to *Oreodon* have recently been discovered in the Loup Fork beds of Montana, and been described by Professor Cope under the names of *Pithecistes*, *Brachymeryx* and *Cyclopidius.* All three are selenodont, have the mandibular symphysis coössified, and a deficiency in the number of the incisor teeth. In the first two genera there are only three premolars. In *Pithecistes* the inferior canine is functionally developed, there are but one or two incisors on each side, and the anterior premolars are broader than long. In *Brachymeryx* the premolars are trenchant except the last superior, which has four columns. The first inferior, is functionally the canine. *Cyclopidius* is similar to *Leptauchenia* in its dentition, excepting in the presence of only two inferior incisors on each side. The frontal region is occupied by enormous vacuities, two of which extend between the orbits, and are separated by the very narrow nasal bones, which, in the type species *C. simus*, do not extend beyond the lachrymal fossæ. The superior facial region is excavated, and the cavity is reached from the sides by a huge foramen in the facial plate of the maxillary bone. A second species, *C. heterodon* is described. The species of the other genera are *P. brevifacies* and *B. feliceps.*

Accompanying these was found a species of *Blastomeryx* (Cope) as large as the black-tailed deer, which is called *B. borealis.* The genus *Blastomeryx* is believed by Professor Cope to be the ancestor of the existing *Cervidæ*, as *Dicrocerus* is of *Antilocapra.*

GEOGRAPHY AND TRAVELS.

NARRATIVE OF HALL'S NORTH POLAR EXPEDITION.[1]—Captain Hall having died on his return to the winter quarters of the Polaris, from his journey to the farthest point north hitherto attained, it was reserved for others to write the record of his daring and successful expedition. The volume contains everything of general interest relating to the origination, organization and the fitting up of the expedition, which was first suggested and organized by Hall himself. One chapter is devoted to an account of Hall's earlier researches and is accompanied by a map illustrating the route he pursued during his eight years of Arctic exploration, which fitted him so well for the crowning work of his life. Geographers will also find in this volume a detailed account (sometimes too irrelevant details are given) of the eventful history of the expedition after Hall's death. The woodcuts are numerous, but are not of a high order of excellence.

STANLEY'S ACCOUNT OF THE CONGO.—Mr. Stanley thus sums up in his letter to the New York *Herald* and the London *Telegraph*, our present knowledge of the Congo River: The entire area the Congo drains embraces about 860,000 square miles. Its source is in that high plateau south of Lake Tanganyika, in a country called Bisa, or Ubisa by the Arabs. The principal tributary feeding Bemba Lake is the Chambezi, a broad, deep river, whose extreme sources must be placed about longitude 33° east. Bemba Lake, called Bangweolo by Livingstone, its discoverer, is a large body of shallow water, about 8,400 square miles in extent. It is the residuum of an enormous lake that in very ancient times must have occupied an area of 500,000 square miles, until by some great convulsion the western maritime mountain chain was riven asunder, and the Congo began to roar through the fracture. Issuing from Bemba Lake, the Congo is known under the name of Luapula, which, after a course of nearly 200 miles, empties into Lake Mweru, a body of water occupying an area of about 1,800 square miles. Falling from Mweru, it receives the name of Lualaba, from the natives of Rua. In Northern Rua it receives an important affluent called the Kàmalondo. Flowing in a direction north by west, it sweeps, with a breadth of about 1400 yards, by Nyangwe Manyema, in latitude 26° 15′ 45″ south, longitude 26° 5′ east, and has an altitude of about 1,450 feet above the ocean. Livingstone, having lost two weeks in his dates, appears, according to Stanford's map of 1874, to have placed Nyangwe in latitude 4° 1′ south, longitude 24° 16′ east, but this wide difference may be due to the carelessness of the draughtsman. Those who feel interested in it should compare it with the latest map

[1] Narrative of the North Polar Expedition, U. S. Ship Polaris, Capt. C. F. Hall, commanding. Edited under the direction of the Hon. G. M. Robeson, Secretary of the Navy, by Rear-Admiral C. H. Davis, U. S. N. U. S. Naval Observatory, 1876. 8° pp., 696.

issued by Stanford, or the map published with the traveler's last journals. The distance the Congo has flowed from its extreme source in Eastern Bisa to Nyangwe Manyema is about 1,100 miles.

EXPLORATIONS IN PALESTINE.—The Palestine Exploration Society, which is supported by voluntary contributions, was organized in 1870 for the purpose of making a scientific survey of the region known in Biblical history as Moab, Gilead and Bashan. In 1873 the first surveying party was sent out, and in 1875 the work of exploration was further extended by a second party, one of the members of which was Dr. Selah Merrill, who gave special attention to the archæology of the regions explored. The work of surveying was soon suspended, however, but Dr. Merrill continued his researches during 1876 and a part of the present year.

At a late meeting of the Society, as reported in the *Tribune*, Dr. Merrill said, in part: "One of the difficulties of exploration in Palestine is caused by the traditions which widely prevail—a difficulty which is experienced in exploration in no other part of the world. Numerous archæological facts have been collected, however, which will be very valuable in the study of the Bible. All explorations are carried on in the face of many obstacles. The climate is very peculiar and severe, and many explorers have lost their lives on this account. The Valley of the Jordan from Lake Tiberias to the Dead Sea, sixty miles in length and about three miles in width, is generally supposed to be a desert, but this is not so. I have examined the Valley of the Jordan on the east side several times, and I am satisfied that it could be easily irrigated from the Jordan itself. It would then become exceedingly fertile, and it is believed that half a million people could live in this valley. Some very important mounds exist in various parts of this region. In the Succoth region there is a very large one, thickly covered with pottery. Into this I wished to dig, for I think some very valuable results may be obtained in this way. It was in this region that King Solomon's brass foundries were situated. I think that the best evidence of the situation of the Cities of the Plain shows that they were at the north end of the Dead Sea. In the region east of the Jordan nearly all the houses are deserted, on account of the Moslem and Turkish rule. You can scarcely travel half an hour in this region without meeting with a valuable ruin. The theatres in many cases were built so as to command fine views of the surrounding country. Between Petra and Damascus there were between 400 and 500 miles of Roman roads. There was also in ancient times an extensive system of irrigation. This was especially apparent in the Valley of the Jabbok, the most fertile portions of which are now under cultivation."

ORTON'S EXPLORATIONS IN SOUTH AMERICA.—Several letters from the late Professor Orton have appeared in the New York

Tribune regarding his explorations in Peru, containing some interesting reflections on the probable number of inhabitants of Peru, at the time of their conquest by Pizarro. He thinks their numbers have been greatly overestimated by historical writers. Good collections of birds, reptiles and fishes were made, which by prearrangement are the property of Professor E. D. Cope.

GEOGRAPHICAL NEWS.—The *Geographical Magazine*, for November, contains a continuation of an interesting description of the island of Formosa, by James Morrison.——Professor Nordienskiöld expects to lead another Swedish Arctic Expedition, to start from Gothenburg about the 1st July, 1878, and *via* Tromsö or Hammerfest, make progress from Novaya Zemlya eastward, trying to force a passage along the coast of Siberia, and returning home through Behring Straits, and by the Suez Canal, thus sailing round Asia and Europe.——Next year the Norwegian Deep Sea Sounding Expedition will examine the region between North Cape, Jan Mayen, and the north of Spitzbergen, and possibly make a trip eastward, in the direction of Novaya Zemlya, to determine the position of the isothermal line of 0° C. at the sea-bottom, this line being considered the limit of the range of codfish.——Count Wilzek and Lieutenant Weyprecht have published a programme of work for the proposed international polar expeditions.——Capt. H. W. Howgate has published an account of the American preliminary Arctic Expedition, now wintering at the head of Cumberland Gulf. ——M. Kelsief has been making researches during the past summer along the Murmanian Coast and in Lapland, for the Moscow Anthropological Exhibition of 1879; he has made a good collection of stone implements and other prehistoric remains.——The geography of the Upper Indus has been made by a Punjab surveyor, who has completed our knowledge of this river.——Savorgnan de Brazza has arrived at Doume, in the Loando country, on his way eastward to the Ponbara Falls. The River Sibumbay, which some geographers have described as a northern affluent of the Congo, turns out to be a feeder of the Ogowai on its left bank.—— An expedition has left Belgium for the exploration of Central Africa. Dr. Maes, of Hasselt, accompanies the expedition as surgeon and naturalist.——Prof. E. S. Morse has returned from Japan after six months explorations in the neighborhood of Tokio, and has made several expeditions into the interior and about the coast, and discovered some prehistoric pottery, etc., of much interest.——Dr. Petermann has published a map of Costa Rica showing the results of Professor Gabb's survey made in 1873-4.

The Proceedings of the Royal Geographical Society, Nos. 4–6, have the following table of contents: No. IV.—Young, On a Recent Sojourn at Lake Nyassa, Central Africa. Mullens, A New Route and New Mode of Traveling into Central Africa. Buchanan, On the Distribution of Salt in the Ocean as indicated by the Specific Gravity of its Waters. Allen, Notes of a Journey through

Formosa from Tamsui to Faiwamfu. Bullock, Trip into the interior of Formosa. Nares, On the Navigation of Smith's Sound, as a Route to the Polar Sea. Carpenter, Lecture on the Temperature of the Deep Sea Bottom and the Conditions by which it is determined. Trotter, The Pundit's Journey from Leh to Lhása and return to India via Assam. Macfarlane, Voyage of the Ellangowam to China Straits, New Guinea. No. V.—Address at the Anniversary Meeting, May 28th, by Sir R. Alcock. No. VI.—Crowther, Notes on the River Niger. Hutchinson, Progress of the Victoria Nyanza Expedition of the Church Missionary Society. Wallace, Lecture on the Comparative Antiquity of Continents as indicated by the Distribution of Living and Extinct Animals. Markham, The Arctic Expedition of 1875–76 (with a map). Simson, Notes of Journeys in the Interior of South America. Smith, The Translation and Transliteration of Chinese Geographical Names. Marsh, Description of a Journey Overland to India, *via* Meshed, Herat, Candahar, and the Bolan Pass, 1872. Kirk, Visit to the Mungao District, near Cape Delgado. Cottam, Overland Route to China, *via* Assam, &c., across the Irrawaddi into Yunan.

Among recent geographical works are the following: S. W. Silver & Co.'s Handbook to the Transvaal; British South Africa, Its Natural Features, Industries, Population and Gold Fields, 1877. South Africa; Its Difficulties and Present State, suggested by a recent visit to that country. By A. R. Campbell Johnson, 1877. South Africa; Past and Present. By John Noble. Loango und die Loankuste. Von Dr. Pechuel-Lösche. Leipzic, 1876. (London, Trübner & Co.)

MICROSCOPY.[1]

New Cabinet for Slides.—Two slide cabinets have recently been described in *Science Gossip* which possess some advantages for certain purposes, and have the no small recommendation that they can be easily and cheaply made.

Mr. T. H. Moorhead's cabinet is in the book form, and is made of card-boards mounted in slate frames. Common school slates are selected, of suitable size and with perfect frames. The frames are carefully smoothed at the corners, stained mahogany color if desired, and varnished and polished. The slates are then removed from them and replaced by card-boards cut to the same size and covered on both sides with fine white paper. Across the cards are stitched bands of silk elastic at such distances that when the card is covered with rows of slides nearly touching each other each row will be crossed and kept down by one band about an inch from the ends of the slides. The band is stitched to the card at intervals of an inch and a quarter, so that each slide will be separately held. Stout canvas can be tacked to the edge of each frame. and the whole bound together, in volumes of about five each, by a

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

bookbinder, forming a really handsome set. If the cards are six and a half by ten inches they will hold fifteen slides on a page. The slides and their labels are well displayed, though they cannot lie in the best position for safe keeping except by allowing the volume to lie flat and leaving the under page of each unused.

Mr. A. W. Stokes, of Guy's hospital, has contrived a slide box, which is less showy than this, but more compact and portable. As a compromise between a stationary cabinet and a box for carrying around, it seems to possess advantages not before attained. A box is made like an ordinary tray-slide box, opening both at the top and front. In this the slides lie flat in several tiers of a single row each, with their ends pointing towards the front of the box. The upper row rests in a tray with a ledge in front, and close to the cover when the box is closed. Below this the rows of slides rest on shelves, each of which projects forward half an inch or more beyond the one above it, so that the slides will also project and the labels of all the rows be visible at once. Stops are arranged between the shelves, behind, to prevent the slides slipping back too far, and between the separate slides on each shelf to prevent their striking together. A piece of card-board or thin wood hinged to the cover falls in a slanting direction across the rows, and keeps the slides from slipping forward in any position of the box when it is closed. The shelves may be of light card-board, as they are well supported by the wooden strips which confine the slides behind and at the sides. A box nine inches long by five inches broad and two inches deep will hold thirty-five slides in five rows or tiers of seven each. [A very neat case may be made of a good cigar box, while another box may be cut up to furnish the ledges or partitions between shelves.]

Diatoms.—Under this title the Industrial Publication Company has produced a neat and useful little book which will be a great convenience to many workers. It is a reprint of three papers on the subject of collecting, preserving, and preparing diatoms, by Professors A. M. Edwards, Christopher Johnston and M. L. Smith, respectively. These excellent papers will be handy in this form even for those whose libraries include the originals in the Lens and the Natural History of New Hampshire.

American Journal of Microscopy.—The great success of this popular journal of microscopy, together with the inconvenience of mailing half-dollars in the present state of our currency, has induced the radical change of doubling its size with a corresponding increase of price. While much better opportunity will thus be obtained for elaborate articles, the simple and elementary character will still be maintained. The change will please many readers and incommode but few.

Microscopical Societies.—The following elections of new officers have taken place since the last list published:—

American Association for the advancement of Science, microscopical subsection, meets annually in connection with the migratory sessions of the association. Chairman for the Nashville meeting, 1877, Dr. R. H. Ward, of Troy, New York; for the St. Louis meeting, 1878, Dr. Geo. S. Blackie, of Nashville, Tenn.

Dunkirk Microscopical Society. President, Geo. E. Blackham, M.D.; secretary and treasurer, A. P. Alling, M.D.

Fairmount Microscopical Society. President, S. H. Griffith, M.D.; secretary and treasurer, Wm. C. Stevenson, Jr.; managers, John Gordon Gray, Thomas D. Ingram, M.D., and Henry Winter Davis.

Nature Club, Albany, New York. Organized October 1877. Microscopy a prominent feature. Meets at residences of members on the second and fourth Monday evenings of each month. President, Geo. T. Stevens, M.D.; vice-president, D. J. Pratt; secretary, Richard Prescott.

State Microscopical Society of Illinois. President, Henry W. Fuller; vice-presidents, Lester Curtis, M.D., and Chas. S. Fellows; secretary, H. F. Atwood; corresponding secretary, O. C. Oliver, M.D.; treasurer, B. W. Thomas; trustees, S. J. Jones, M.D., Professor E. Bastin, W. H. Summers, H. M. Thompson and James Colgrove.

Troy Scientific Association; microscopical section. Chairman, R. H. Ward, M.D.; vice-chairman, Rev. A. B. Hervey; secretary, Professor A. W. Bower.

Tyndall Association; section of microscopy. President, Rev. I. F. Stidham; secretary and treasurer, Curtis C. Howard; curator, Professor T. C. Mendenhall.

Exchanges.—A Curtis' section cutter, made by Miller, of New York (cost $20.00), for microscopical objects or books. Address offers to C. E. H., No. 1 Gale Place, Troy, N. Y.

Plumule scales of small cabbage butterfly (*Pieris rapæ*), mounted, for good slides. Address Edward Pennock, 805 Franklin street, Philadelphia.

Very fine mountings of shells from the Bermudas, for objects of special interest. Address C. C. Merriman, Rochester, N. Y.

Material: Marine algæ, diatoms in situ on algæ from east and west coasts, musci, lichens, ferns, lycopodia, garnet sand, &c., in exchange for mounted slides. M. A. Booth, Longmeadow, Mass.

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SCIENTIFIC NEWS.

— Two articles on the evolution of nerves and nerve-systems, illustrated by the structure of *Aurelia*, a type of the lowest group of animals in which a nervous system appears, have been pub-

lished by G. J. Romanes, in *Nature*, for July 26th, and August 2d. By removing the eight nervous ganglia, the whole disc of the jelly-fish presents not merely the protoplasmic qualities of excitability and contractility, but also the essentially nervous quality of conducting stimuli to a distance irrespective of the passage of a contractile wave. He therefore concludes that there can be no longer any question that we have here to deal with a tissue already so far differentiated from primitive protoplasm, that the distinguishing function of nerve has become fully established.

— Dr. Sachs, who was sent to Venezuela by the Berlin Academy of Science, for the purpose of studying the electric eel in its native haunts, has returned, says *Nature*, after an absence of ten months, with a rich store of valuable observations.—A second specimen of *Archæopteryx lithographica* has been discovered near Solenhofen; this specimen is much more perfect than the other, and possesses the entire head.—The bones of the skull of *Amia calva* have been described in detail by T. W. Bridge, in the English *Journal of Anatomy and Physiology*.

— Professor E. D. Cope has lately visited the Nickajack Cave near Chattanooga in Company with Professors Loverell and Nipher, Dr. Walker and Mr. Lindsley. The cave is as large as the Mammoth or Wyandotte caves, and is traversed by a large stream. He found an abundance of a blind craw-fish and several small crustacea, some of them allied to Cæcidotæa. He also procured the myripod, *Spirostrephon cavernarum*, a spider with eyes, and a Raphidophora, etc.

— We have received some advance sheets of Erklärungen zu den Zoologischen Wandtafeln, herausgegeben von R. Leuckart, professor in Leipzig, and Dr. H. Nitsche, professor in Tharand. Taf. i.–iii. Cassel, Theodor Fischer, 1877. These are colored diagrams, printed from stone, and are well selected and in all respects admirable. They are designed for the use of schools and colleges, and the series will, when finished, comprise about one hundred sheets, accompanied by an explanation of each plate in German, French and English. The price to subscribers for the whole work will be from eighty pfennigs to two marks (a mark is 32 cents). It will be seen by this that the diagrams as a whole will be quite cheap.

— The death of Professor James Orton, occurred about the 24th of October last, while he was crossing Lake Titicaca, *en route* for Puno. He had been some time in Bolivia, and having relinquished his journey to the Beni River, was on his way home. Professor James Orton was bora at Seneca Falls, N. Y., April 21, 1830. He was graduated at Williams College in 1855, and in 1858 at the Andover Theological Seminary. After traveling in Europe and in the East, he was ordained a congregational minister in 1860. In 1866 he became instructor in the natural sciences at Rochester University. The year following he went at

the head of an expedition from Williams College to South America. On this occasion he crossed the continent by Quito, the Napo and the Amazon, discovering the first fossils found in the Amazon valley. In 1869 he became Professor of Natural History at Vassar College. In 1873 Professor Orton made a second journey across South America, from Para up the Amazon to Lima and Lake Titicaca. About a year ago Professor Orton returned once more to South America, to undertake alone and with limited means, the exploration of the Great Beni River, which carries the waters of Eastern Bolivia to the Amazon, by way of the Madeira. His works are: "The Miner's Guide and Metallurgists' Directory" (1849); "The Proverbalist and Poet" (1852); The Andes and the Amazon" (1870); "Underground Treasures; How and Where to Find Them" (1872); and "Comparative Zoology" (1875).

— Messrs. S. H. Scudder, of Cambridge, and F. C. Bowditch, of Boston, have just returned from a two months' tour in Colorado, Wyoming and Utah, where, under the direction of Dr. Hayden, they have been exploring for fossil insects, and collecting specimens especially in the high regions. They report having secured many specimens of fossil insects at different points along the railways from Pueblo to Cheyenne, and from Cheyenne to Salt Lake, as well as at Lakin, Kansas, and Garland, and Georgetown, Col., and in various parts of the South Park and surrounding region. Ten days were spent at Green River, and in that vicinity, in exploring the tertiary strata for fossil insects, but with very unsatisfactory results. Near Florisant, the tertiary basin was found to be exceedingly rich in insects and plants. Mr. Scudder spent several days in the careful survey of this basin, and estimates that the extent of the insect-bearing shales there is at least fifty times as great as that of those in Southern Bavaria. Six or seven thousand specimens of insects, and 2,000 or 3,000 of plants have already been received from Florisant, and as many more are expected before the close of the year. Arrangements were also made with persons who have found a new and rich deposit of fossils in the tertiary strata in Wyoming, to forward all the specimens obtained there.

Mr. Scudder believes that the tertiary strata of the Rocky Mountain region are richer in the remains of fossil insects than any others in the world, and that within the next few months the amount of material at hand for the study of the subject, will be greater than was ever before possessed by any single naturalist.

— Professor Joseph Leidy, the comparative anatomist and microscopist, has also recently returned from his second visit to the West, under the direction of Dr. Hayden. His field of operations during the past season, was the country about Fort Bridger, Unitah Mountains and the Salt Lake Basin. The specimens he has collected comprise the lowest and simplest forms of animal life,

the most minute requiring high microscopic power to distinguish their structure.

—Captain Howgate has received a letter via Scotland, from Captain Tyson, who commands the *Florence*, the advance vessel of the American Arctic Expedition. It is dated September 29, and reports Captain Tyson's safe arrival at Niuntilick Harbor, Cumberland Gulf, after a tedious voyage of forty days. He proposes moving to the head of the gulf in a few days, to go into winter quarters, and carry out his instructions in reference to the collection of material. The crew were all in good health and spirits. Messrs. Sherman and Kumlein are reported as doing well in their respective departments.

—We regret to learn that the note on page 749, volume xi, has been regarded by Dr. Brewer as too personal, and construed as an affront. The writer begs us to disclaim for him the slightest intention of reflecting upon Dr. Brewer's veracity and sincerity in his conduct of the sparrow controversy. The bantering sentence seemed to bear its own credentials; but since it has been misconstrued, the writer permits us to substitute the following: "Dr. Thomas M. Brewer, has so long remained in what I consider to be his honest misapprehension of the real bearing of alleged facts, in the face of testimony no less explicit, that it is no longer a question with me whether he will continue to argue as heretofore against such bearing of the testimony.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

National Academy of Science.—At the session held in New York, October 23d to 25th, the following papers on subjects relating to natural science were read: On the Development of Flounders, by A. Agassiz. On the Morphology of the Antlers of the Cervidæ, by Theodore Gill. On some new Fossil Fishes from Ohio and Indiana; on the Geological Age of the Western Lignites, by J. S. Newberry. On some Gigantic Dinosaurian Reptiles from the Wealden of the Rocky Mountains; American Cretaceous Birds, by O. C. Marsh. On the Air-Sacs of Locusts, by A. S. Packard, Jr. On the Glycogenic Functions of the Liver, and its relation to Vital Force and Vital Heat, by Joseph Le-Conte. Biographical Memoir of Louis Agassiz. First part, relating to his Life and Work in Europe, by A. Guyot.

Academy of Science, St. Louis, Nov. 5.—Dr. Engelmann presented an additional paper on the curious mode of fertilization of the *Agave shawii*. Dr. Engelmann expatiated upon the process of development of the flower. It opens in the evening, and anthers shed

pollen that night, while the stigma is not ready for four or five days to receive the pollen. The rest of the flower withers while the stigma is secreting its liquid.

President Riley read a communication on the life-history of the blister-beetles. After showing that, notwithstanding the importance to commerce and to the pharmacopœa, of the well-known Spanish fly (*Cantharis vesicatoria*), its early life-habits have yet remained a mystery. The same holds true of our American blister-beetles, many of which have the same valuable vesicatory power. The fact that their transformations have hitherto eluded investigation is all the more remarkable that some of the species abound during certain years and are quite injurious to potatoes, tomatoes, beans and other cultivated plants. Prof. Riley has discovered that they prey in the larva state on locust eggs, and he has reared several species from the eggs of that western scourge, the Rocky mountain locust. These blister-beetles are remarkable for passing through many curious changes, which are known as hypermetamorphoses. After illustrating these, Professor Riley gave the following summary:

From the foregoing history of our commoner blister-beetles, it is clear that while they pass through the curious hypermetamorphoses so characteristic of the family, and have many other features in common, yet Epicauta and Macrobasis differ in many important respects from Meloe and Sitaris, the only genera hitherto fully known biologically. To resume what is known of the larval habits of the family, we have:

First, the small, smooth, unarmed, tapering triungulin of the prolific Sitaris, with the thoracic joints subequal, with strong, articulating tarsal claws on the stout-thighed but spineless legs, and, in addition, a caudal spinning apparatus. The mandibles scarcely extend beyond the labrum; the creature seeks the light, and is admirably adapted to adhering to bees but not to burrowing in the ground. The second larva is mellivorous, and the transformations from the coarctate larval stage all take place within the unrent larval skin. We have:

Second, the more spinous and larger triungulin of the still more prolific Meloe, with long caudal setæ, but otherwise closely resembling that of Sitaris in the femoral, tarsal and trophial characters, in the subequal thoracic joints, in the unarmed tibiæ, and in the instinctive love of light and fondness for fastening to bees. The second larva is also mellivorous, but the later transformations take place in the rent and partly shed skins of the second and coarctate larva. We have:

Third, the larger and much more spinous triungulins of the less prolific Epicauta, Macrobasis and Henous, with unequal thoracic joints, powerful mandibles and maxillæ, shortened labrum, slender femora, well-armed tibiæ, slender, spine-like, less perfect tarsal claws—combined with an instinctive love of darkness and tendency to burrow and hide in the ground. The second

larva takes the same food as the first, its skin is almost entirely cast from the coarctate larva, while the subsequent changes are independent and entirely free of the shell of this last.

THE IOWA ACADEMY OF SCIENCE, Sep. 26.—Among the papers read were Observations on the structure of the leaves of *Silphium laciniatum*, by President Bessey. The paper embodied the result of microscopic observations on sections of the leaves of the compass plant. As all know, the blade of the leaves of this plant is always in, or nearly in, the plane of the meridian, and the purpose of the investigation was to determine whether this polarity is correlated with any peculiarity of structure. In ordinary leaves the cells making up the green pulp are differently arranged on the two sides of the blade, being packed closely together beneath the upper surface, forming what is called *palisade* tissue. If leaves be turned so as to expose the under surface to the sun, they either twist the leaf stalk and bring the palisade tissue to the light or die. Every leaf makes an effort to keep the proper upper surface, only, exposed The investigation shows that the two surfaces of compass plant leaves are exactly alike as to structure, both in the matter of palisade tissue and arrangement of the veins. Both sides therefore are equally affected by light, and the equal struggle of the two sides to turn toward the sun gives the blade a position about parallel to the meridian.

A second paper by President Bessey was on dimorphism in Lithospermum. This paper was illustrated by diagrams, and pointed out that while there is complete dimorphism in *Lithospermum canescens*, there is only an appearance of dimorphism in *Lithospermum longiflorum*, due entirely to the varying length of the corolla tube. In early summer, the last named plant bears showy flowers, the corollas of which vary in length from one to two inches. The stamens are always about the same distance from the mouth of the corolla, while the stigma borne on a style that is nearly constant in length, is sometimes above and sometimes below them. In place of dimorphism there is simply extreme and inconstant variation.

Later in the season this plant produces only minute flowers that are not more than a tenth of an inch in length. These later flowers are always self-fertilized.

Professor Todd read a paper on the distribution of forests in South-western Iowa, with considerations regarding the origin of prairies. The writer presented facts showing that the position of prairie and forest is not altogether determined by fires, the fineness of the soil, nor even the distribution of rain, but rather by the constancy of moisture in the air and soil. For example in South-western Iowa , over areas that are essentially identical as regards soil and precipitation, the north slopes are constantly timbered, while the southward-facing slopes are bare.

BOSTON SOCIETY OF NATURAL HISTORY, NOV. 21.—Mr. S. W.

Garman read a paper on some features of erosion in the temperate zones. Dec. 5.—Mr. S. H. Scudder made a communication on certain interesting articulates from the Carboniferous rocks of Illinois, and Professor A. Hyatt remarked on the evolution of the races of *Planorbis multiformis*.

New York Academy of Sciences, Nov. 19.—Professor J. S. St. John read a paper on the application of dry plate photography in preparing, without a camera, glass transparencies of sections of fossils for projection (with lantern illustrations). Professor T. Egleston spoke of some remarkable forms of amethysts from Brazil; and Mr. A. A. Julien remarked on the chemical and microscopical characters of certain American rocks.

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SCIENTIFIC SERIALS.[1]

Quarterly Journal of Microscopical Science.—October. Loxosoma, by Carl Vogt. Abstracted and annotated by the Rev. J. Hincks. On the minute structural Relations of the Red Blood Corpuscles, by A. Boettcher. Notes on the Embryology and Classification of the Animal Kingdom: comprising a Revision of Speculations relative to the Origin and Significance of the Germ-layers, by E. R. Lankester.

The Geological Magazine.—November. American Surface Geology, and its relations to British: with some Remarks on Glacial Conditions in Britain and "The Great Ice Age" of Mr. James Geikie (Part i.), by S. V. Wood. Across Europe and Asia, Part vi. Tornsk to Irkutsk, by J. Milne.

Annals and Magazine of Natural History.—November. On a Carboniferous Hyalonema and other Sponges from Ayrshire, by Prof. and Mr. J. Young.

Annales des Sciences Naturelles.—October 15. Recherches pour servir à l'Histoire de la Respiration chez les Poissons, par M. Jobert. Recherches pour servir a l'Histoire du Bâtonnet optique chez les Crustacés et les Vers, par J. Chatin.

The Geographical Magazine.—November. Quetta and the Afghans, by H. G. Raverty. The Island of Perim.

Canadian Entomologist.—November. Pieris vernalis a variety of Pieris protodice, by T. E. Bean. An account of some farther experiments upon the effect of cold in changing the Form of certain Butterflies, by W. H. Edwards.

[1] The articles enumerated under this head are usually selected.

THE

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ON THE SAURIANS RECENTLY DISCOVERED IN THE DAKOTA BEDS OF COLORADO.

BY E. D. COPE.

THE formation known as the Dakota was long since characterized by Messrs. Meek and Hayden, from the studies made by the latter gentleman, of the great section exhibited by the Missouri river. Subsequently Dr. Hayden, then as now, the esteemed director of the United States Geological Survey of the territories, observed and defined the same horizon along the eastern flank of the Rocky mountains. Doctor J. S. Newberry, in his reports on the geology of the Colorado basin, has mentioned the same stratum under the name of Lower Cretaceous sandstone, and I have in my report to Lieut. Geo. M. Wheeler identified that part of these sandstones which is seen in northwestern New Mexico, with the Dakota. This formation is then one of great extent and importance. It consists chiefly of sandstones which are sometimes so amorphous as to constitute a quartzite. Among these are interstratified beds of clay, carbonaceous clay, and lignite, some of which may be used as an inferior fuel. These mineral characters show that the formation was, as pointed out by Prof. Newberry, deposited in shallow water during a period of subsidence. He remarks that previous to this subsidence there was an extensive land area; but that it steadily diminished by the encroachments of the ocean. This period of extended dry land, would be regarded by many geologists as a part of the great cretaceous division of time; that occupied in its sinking, and in the deposit of new beds, being now paralellized with the later half of the cretaceous period of the old world scale. In any case the deposit of the sands which became the Dakota rocks, marks the beginning of the cretaceous ocean in North America, and is the No. 1 of Meek and Hayden.

Along both the eastern and western flanks of the Rocky mountains the Dakota beds form a distinctive feature of the landscape. Their hardness has resisted the effects of erosion so that they remain prominent where other beds have been worn away. As all the earlier cretaceous strata lie tilted up against the great central axis, the harder ones form lines of hills or "hog backs," while parallel valleys mark the upturned edges of the softer ones. This role is played by formation No. 2, as has been often shown by Dr. Hayden. The side of the sandstone ridge next the mountains is steep, while the opposite one is sloping, and the summit is is often a narrow ledge. On this elevated perch the ancient Pueblos of New Mexico fixed their rock built houses, courting one peril to escape the greatest of all, the attacks of savage men. To-day these ruined abodes form the resting places of the geologist, the true lover of scenery, who climbs for birds-eye views of his favorite subjects, and for clews to many a knotty problem.

As a shore and shallow water formation, the Dakota should enclose the remains of the plants and animals of the land. And plants have been found in abundance, and have been the theme of an interesting volume of the Hayden series by Mr. Lesquereux, but vertebrate remains were until recently unknown. To ascertain what forms of animal life ranged that unexplored and unexplorable continent, is a problem that stimulated the writer to many excursions among the "hog backs" of Colorado and New Mexico; and many cliffs have been scaled, and many fasts endured without result in this direction.

Fig. 1—Cervical vertebra of *Camarasaurus supremus*. *a* from above; *b* from right side. The neural arch is mostly wanting. These figures, like all the others in this paper, are one-tenth natural size.

It was therefore a source of no small gratification to have been in receipt of letters from Superintendent O. W. Lucas, of Canyon City, and Professor Arthur Lakes, of Morrison (both in Colorado and one hundred miles apart), at about the same time, informing me of their simultaneous discoveries of vertebrate remains in the beds of Dakota age, near their respective residences. The bones obtained by the former were found in a rather friable bed, and were easily extracted in good condition. Some of those obtained by the latter gentlemen were from a similar or identical formation,

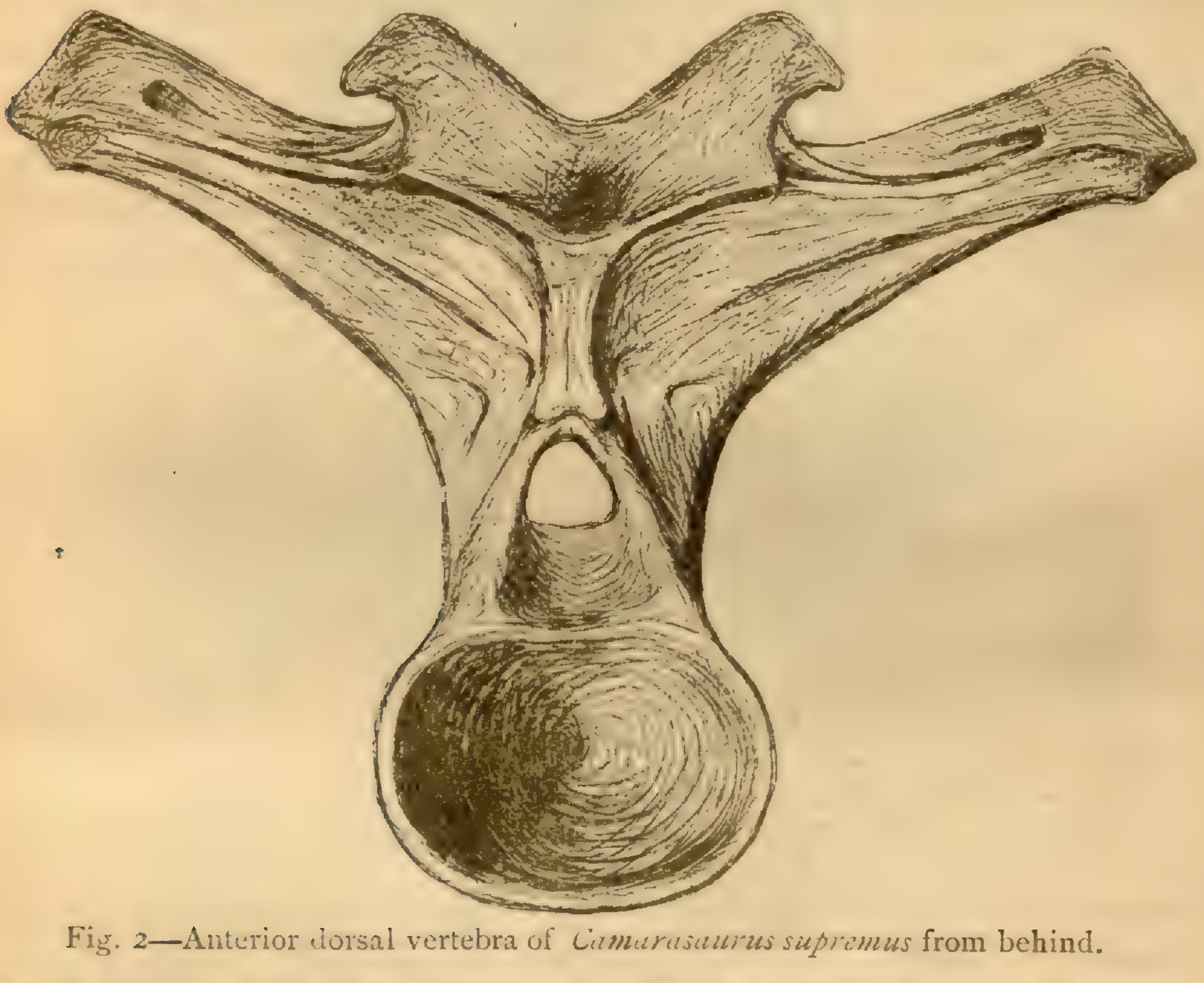


Fig. 2—Anterior dorsal vertebra of *Camarasaurus supremus* from behind.

while others were embedded in the hard sandstone already mentioned. I obtained possession of those from near Canyon city, while those from near Morrison were purchased for the museum of Yale college.

One of the first objects sent by Mr. Lucas is a fragmentary lower jaw of a carnivorous dinosaurian, which he found on the surface of the ground. This fossil was found to belong to a species heretofore unknown, which I referred to the genus *Laelaps*, under the name of *Laelaps trihedrodon*.[1] The second sending included a number of vertebræ, which apparently represent a much more gigantic animal, and I believe the largest or most bulky animal capable of progression on land, of which we have any knowledge. This rep-

[1] Bullet. U. S. Geol. Surv. Terrs. III, 1877, p. 805.

tile I described in my palæontological bulletin No. 26, under the name of *Camarasaurus supremus.* Subsequent sendings included many of the more important bones of the skeleton, which render

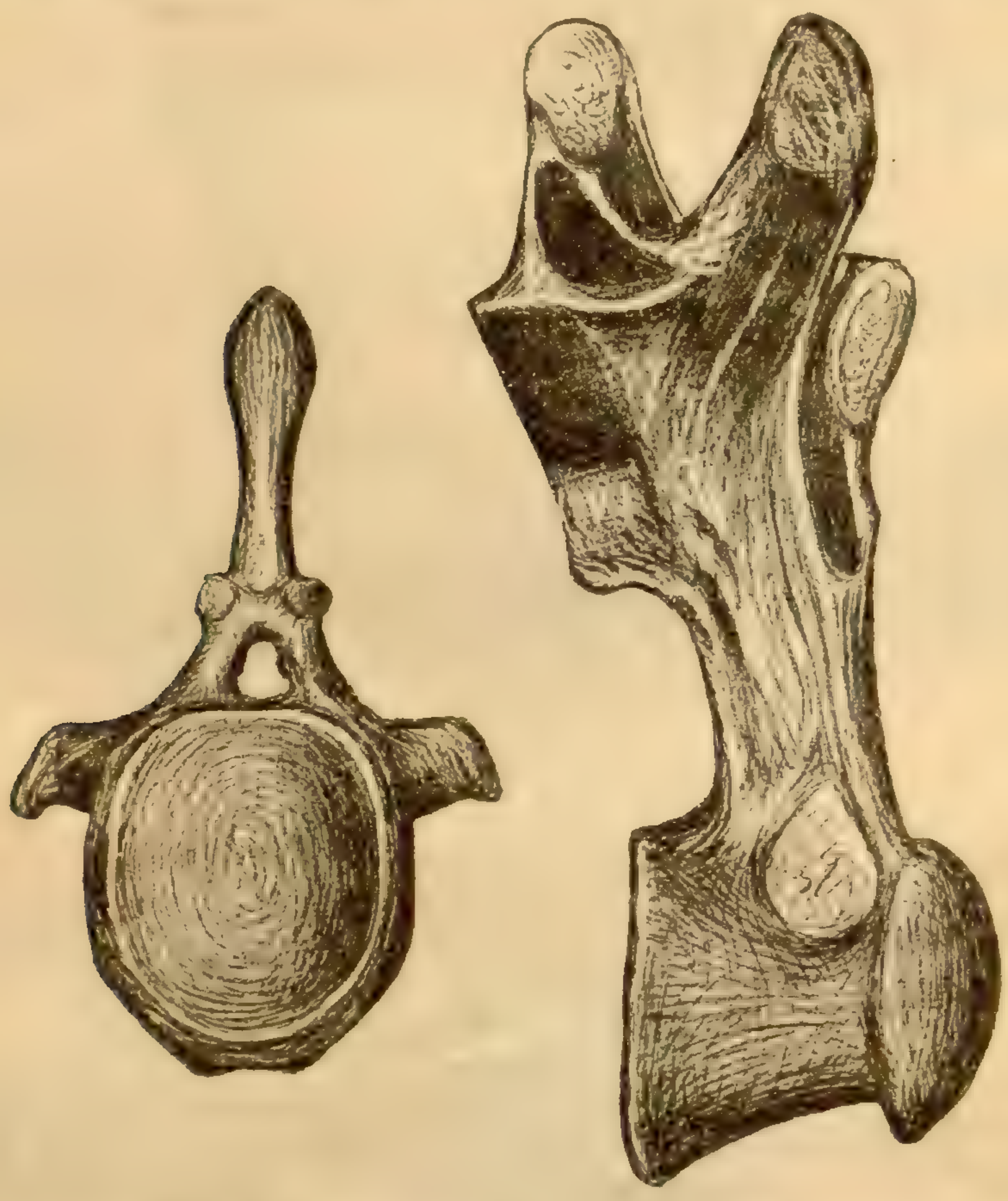


Fig. 4. Fig. 3.

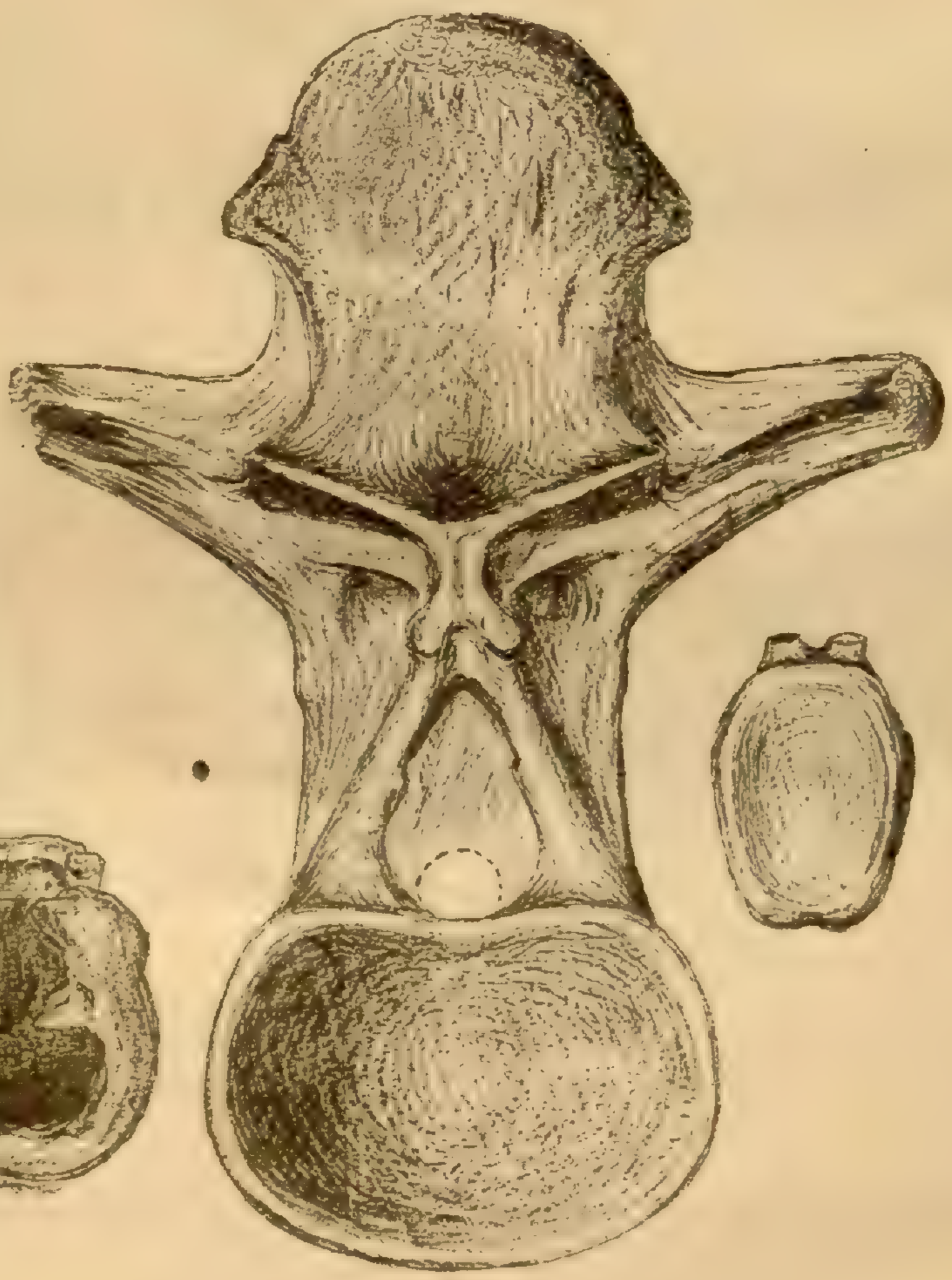
Fig. 3—Dorsal vertebra represented in Fig. 1, the right sight side. Fig. 4—A caudal vertebra viewed from behind.

it comparatively easy to determine the general character of this monster. Later collections received from Mr. Lucas include the teeth of two large species of a new genus which has been characterized under the name of *Caulodon;* and the vertebræ of two genera new to science, which I have named *Tichosteus* and *Symphyrophus.* He also procured remains of two additional forms of gigantic size, fit rivals of the *Camarasaurus*, which I referred to the new genus *Amphicœlias.* A species of tortoise was associated with these saurians, and appears to have been abundant. It is the oldest species of the order yet obtained from American formations, and is not very different from existing forms.

The species of *Camarasaurus* and *Amphicœlias*, which attained to the most gigantic proportions, are remarkable for the light construction of the vertebræ anterior to the tail. In both genera

the centra of dorsal vertebræ are hollow, including two large chambers which are separated by a longitudinal median wall, and communicate with the cavity of the body by a foramen on each side. This is well exhibited by a centrum shown in fig. 6, from which the anterior wall has been removed, and the mineral contents of the chambers extracted. The communication of the latter with the abdominal cavity is seen on the left side, while the foramen of the right side (of the figure) is concealed by its anterior border, which remains.

Fig. 7.



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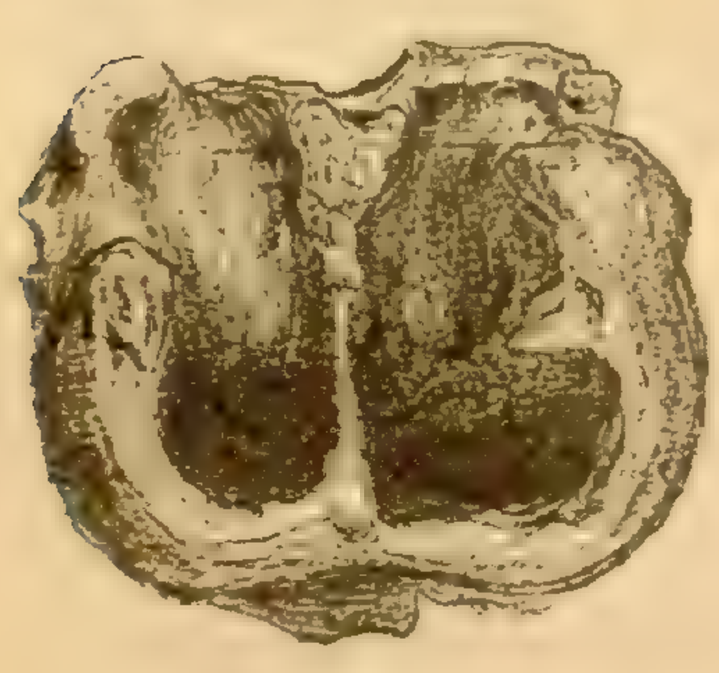


Fig. 6.

Fig. 5.

Fig. 5—A median dorsal vertebra seen from behind, showing the hyposphen. Fig. 6—Centrum of a dorsal vertebra without anterior wall. Fig. 7—Caudal vertebra shown in fig. 4, from the right side. Fig. 8—A more posterior caudal, end view of the centrum.

They are also remarkable for the enormous elevation of the superior arches, and diapophyses, the result of which is to give the ribs an unusually elevated basis, and the cavity of the body much space above the vertebral axis on each side. On the other

hand the bones of the tail and limbs are solid or nearly so, in great contrast with some of the *Dinosauria* of later geological periods.

The manner of the mutual articulation of the arches of the vertebræ in the genera *Camarasaurus* and *Amphicœlias* is very peculiar, and has not been observed in any other animals.

The anterior zygapophyses are separated by a deep fissure, while the posterior zygapophyses are united on the middle line. From the latter from the point of junction, there descends a vertical plate which rapidly expands laterally, forming a wedge whose base looks downward. The supero-lateral faces are flat, and articulate with corresponding facets on the inferior side of the anterior zygapophyses, which look downward and inward, on each side of the fissure above described. When in relation, the anterior zygapophyses occupy a position between the posterior zygapophyses above, and the *hyposphen*, as I have termed the inferior reverse wedge, below. This arrangement accomplishes the purpose effected by the zygosphenal articulation, that is the strengthening of the articulation between the neural arches, but in a different way. The additional articulation is placed at the opposite extremity of the vertebræ, and it is the anterior zygapophysis instead of the posterior one which is embraced. This structure entitles the genera which possess it to family rank, and as the two genera mentioned above belong to different families in consequence of the different types of vertebral centra, the one opisthocœlous, the other amphicœlous, they have been called *Camarasauridæ* and *Amphicœlidæ* respectively.

This structure is readily seen by reference to Figs. 5 and 13, where it is represented in the vertebræ of the two genera from behind. In Fig. 2 it is replaced by a stouter vertical plate of bone, which spreads out a little below. It is seen in profile in Fig. 3. It is not present in the vertebræ of the tail.

The characters of the genus *Camarasaurus* are derived from nearly all portions of the skeleton excepting the skull and ungues. The bones are generally in good preservation.

The vertebræ of the cervical, dorsal and lumbar region are all opisthocœlous or reversed ball and socket. The centra of the cervicals are very elongate, but those which follow them diminish rapidly in length, until in the lumbar region they have but a small anteroposterior diameter. The anterior caudal vertebræ are also

very short and wide; but the length of the centra gradually increases, so that the distal ones are quite elongate. The caudal centra are all moderately amphicœlous.

The sacrum is short and consists of only four vertebral centra, thoroughly coössified. The anterior articular extremity is convex; that of the posterior extremity slightly concave. Its transverse processes are, like those of the other vertebræ, much elevated, although they spring from the centra. The external face of their bases is not prominent, and the spaces between their projecting portions are deeply excavated. The centra are like those of the caudal vertebræ, composed of dense bone. The extremities of the adjacent transverse processes are united, thus enclosing large foramina.

Fig. 9--View of the right side of the dorsal vertebra of *Camarasaurus supremus*, represented in Fig. 5.

The scapula is relatively of large size. It is rather elongate, and the superior extremity is expanded. There is a very large mesoscapular process, which is wanting in *Cetiosaurus*, according to Phillip's figures. It appears to resemble the scapula in *Dystrophæus*.[1] (See Fig. 10.)

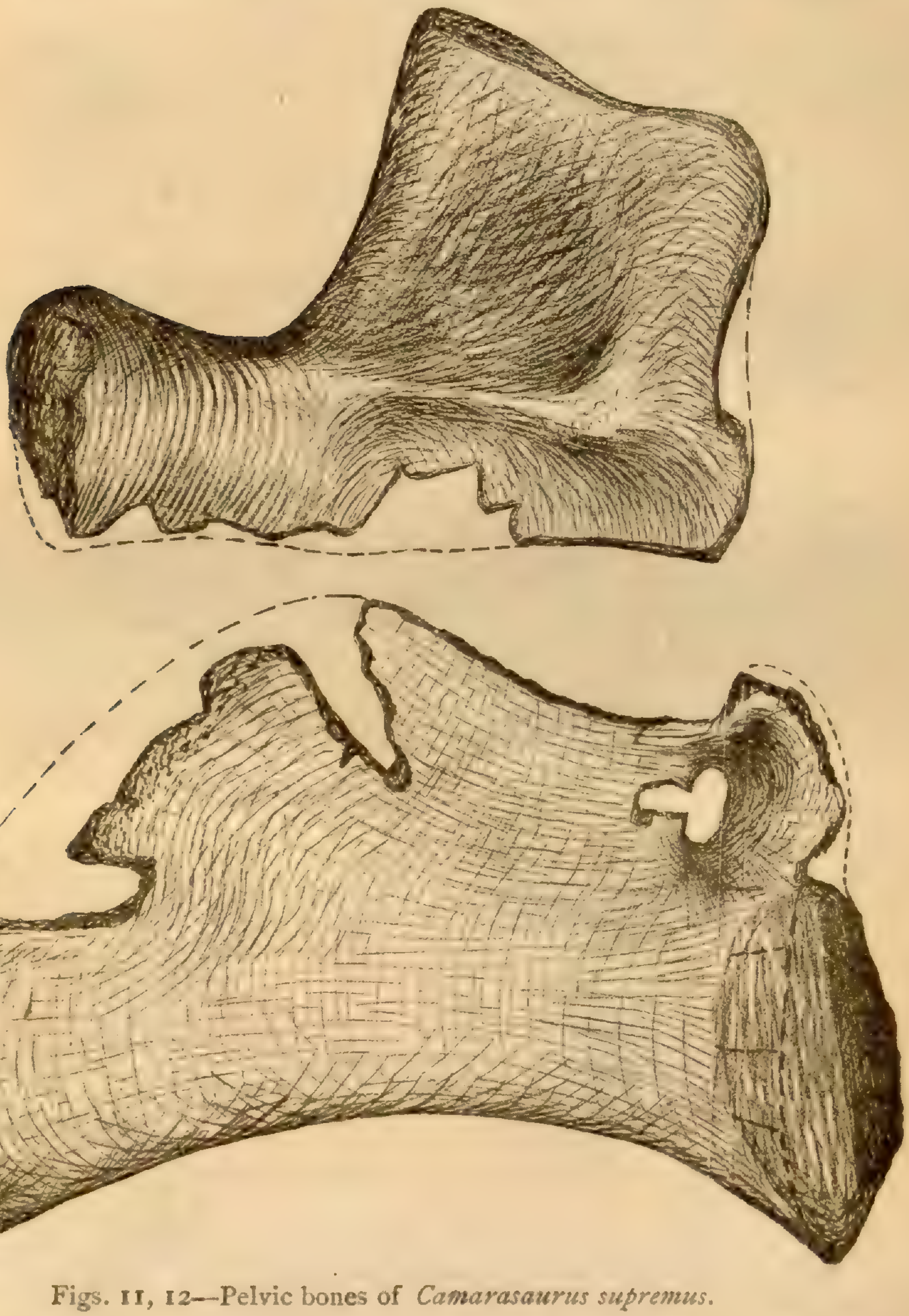
The coracoid bone is of proportionately small size. It is of an irregularly quadrate form, with the proximal extremity the shortest. The articular face is large, and is presented obliquely away from the long axis of the plate. There are no emarginations nor intermediate processes, and the perforating foramen is well removed from the border.

Pelvic bones of two forms are present. Neither of them resembles pelvic bones of *Dinosauria*, and are least of all similar to the forms of ilium which are known in that order. One of them is a robust L-shaped bone, one limb of which is expanded into a wide fan-shaped plate; and the other is stouter and of subequal width, terminating in a stout sub-triangular articular extremity.

[1] See Report Lt. Wheeler, Vol. IV, pl. LXXXIII, p. 31.

Fig. 10—The right scapula of *Camarasaurus supremus*, external view.

But one species of *Camarasaurus* has as yet been discovered. This I have named *C. supremus*, in allusion to its huge size. The bones, so far discovered by Mr. Lucas, are: a cervical and twenty dorsal and lumbar vertebræ, with twenty caudals. Both scapulæ and coracoids were recovered, with one-half of the sacrum, and two pairs of pelvic bones. Of the hind limb I have the femur, with



Figs. 11, 12—Pelvic bones of *Camarasaurus supremus*.

a tibia less certainly belonging to the same animal, although found among the other bones. There is one metapodial. There are many other bones which I have not yet reconstructed or determined.

The dimensions of this animal may be inferred from the fact that the cervical vertebra is twenty inches in length and twelve in transverse diameter; and that one of the dorsals measures three and a half feet in the spread of its diapophyses, two and a half feet in elevation, and the centrum thirteen inches in transverse diameter. Another dorsal is two feet ten inches in elevation.

The femur already mentioned is six feet, and the scapula five

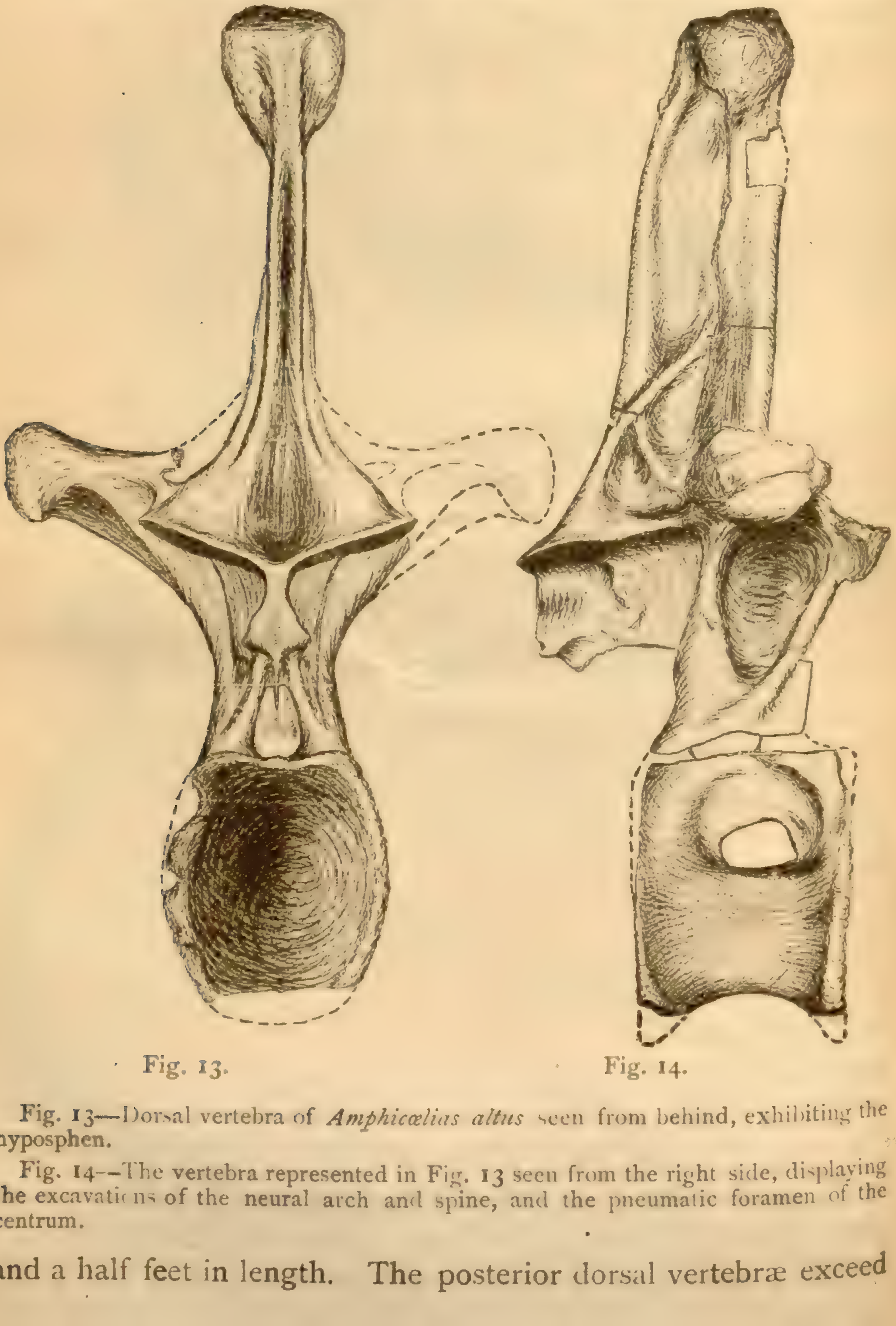


Fig. 13. Fig. 14.

Fig. 13—Dorsal vertebra of *Amphicœlias altus* seen from behind, exhibiting the hyposphen.

Fig. 14—The vertebra represented in Fig. 13 seen from the right side, displaying the excavations of the neural arch and spine, and the pneumatic foramen of the centrum.

and a half feet in length. The posterior dorsal vertebræ exceed

in dimensions those of any known saurian, equaling those of the right whale. The centra measure sixteen inches in transverse diameter. The neck was probably ten feet in length.

That this species was capable of and accustomed to progression on land, is certain from the characters of the bones of the limbs and their supports above described. The extraordinary provision for lightening the weight of a portion of the skeleton has more than one significance. It must be borne in mind that the caudal vertebræ retain the solid character seen in those genera which stood habitually on their hind limbs. That the present species was herbivorous is suggested simply by its huge dimensions, and the natural difficulty of supplying itself with animal food.

The scapula is enormous as compared with the pelvic bones. The sacrum is also small and short, showing that the weight was not borne on the hinder limbs. The great length of the humerus in the probably allied genus *Dystrophæus*, from the Trias of Utah, adds to the probability that the same bones were large in *Camarasaurus*. This character, taken in connection with the remarkably long neck possessed by that genus, suggests a resemblance in form and habits between those huge reptiles and the giraffe. While some of the later *Dinosauria* elevated themselves on their hind limbs to reach the tree-tops on which they fed, the general form of the body in some of these earlier types enabled them to reach their food without the anterior limbs leaving the earth.

The vertebræ from all parts of the column of *Camarasaurus* are known, and those of the dorsal and lumbar regions present the extraordinary character, of which a trace is seen in *Cetiosaurus*, of neural spines expanded transversely to the axis of the column. Numerous vertebræ of *Amphicælias* are known, and in the dorsals in which the neural spine is preserved, the latter displays the usual form, that is, it is compressed in the direction of the axis of the column. The centra differ from those of *Camarasaurus* in the form of their articular extremities, resembling more nearly in this respect the genus *Tichosteus* Cope (Palæontological Bulletin, No. 26, p. 194). They are unequally amphicœlous, the posterior extremity being more concave, and with prominent margins; while the opposite one is less expanded, and is but slightly concave. The neural arch is coössified to the centrum, and there is no capitular costal articulation on the latter.

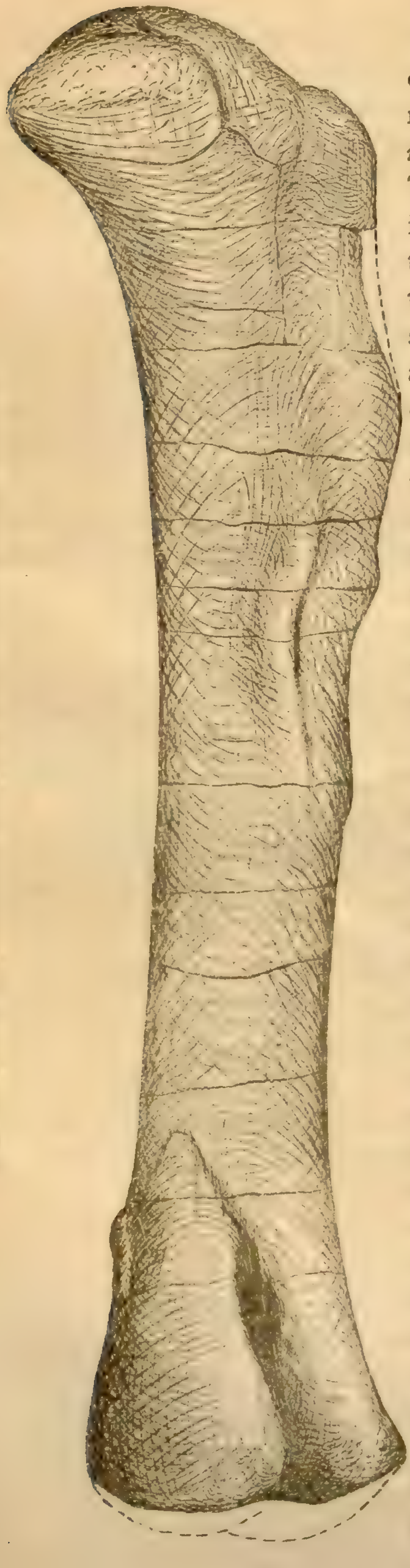


Fig. 15—Femur of *Amphicœlias altus*, seen from the inner posterior direction.

The lightness of construction of the vertebræ of this genus is as remarkable as in the *Camarasaurus*, but is differently exhibited. The greater fore and aft extent is seen in the fossæ, which are therefore not so deeply excavated as in that genus, but the osseous walls are not less lightened and attenuated. The elevation of the middle line of the back must have been extraordinary in the *Amphicœlias altus* (Figs. 13, 14), and the huge knob at the summit of the neural spine indicates the strength of the longitudinal ligament which connected the vertebræ with each other and with the head.

The femur of *Amphicœlias altus* is remarkable for its slender form. It is a few inches longer than that of the *Camarasaurus supremus*, but is not so robust. The shaft is nearly round and somewhat contracted at the middle, where it is slightly convex backwards. It is slightly curved inwards at the great trochanter. Here the shaft is moderately grooved on the posterior face. This trochanter is only a prominent ledge below the head. The third trochanter is situated a little above the middle of the shaft; it is a prominent obtuse ridge directed backwards. The condyles are extended well posteriorly, and are separated by a deep popliteal groove, which originates on the

inferior portion of the shaft. They are also separated anteriorly by a shallow open groove. The external condyle is rather more robust than the internal.

The length of the femur is six feet four inches; the elevation

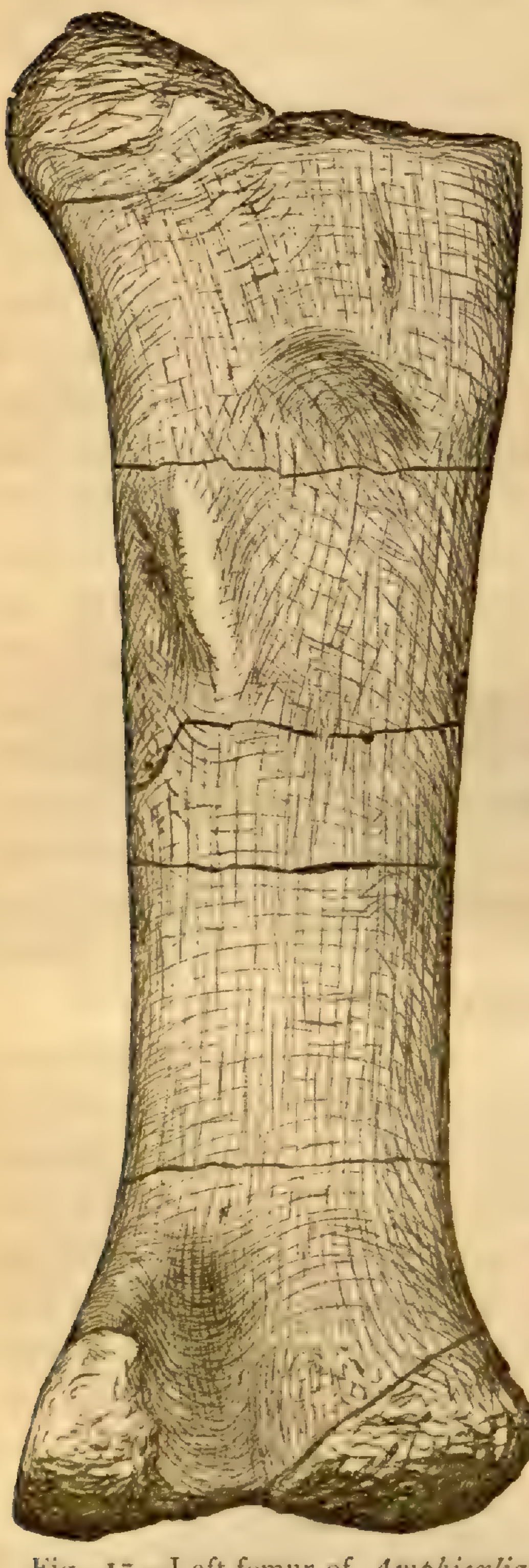
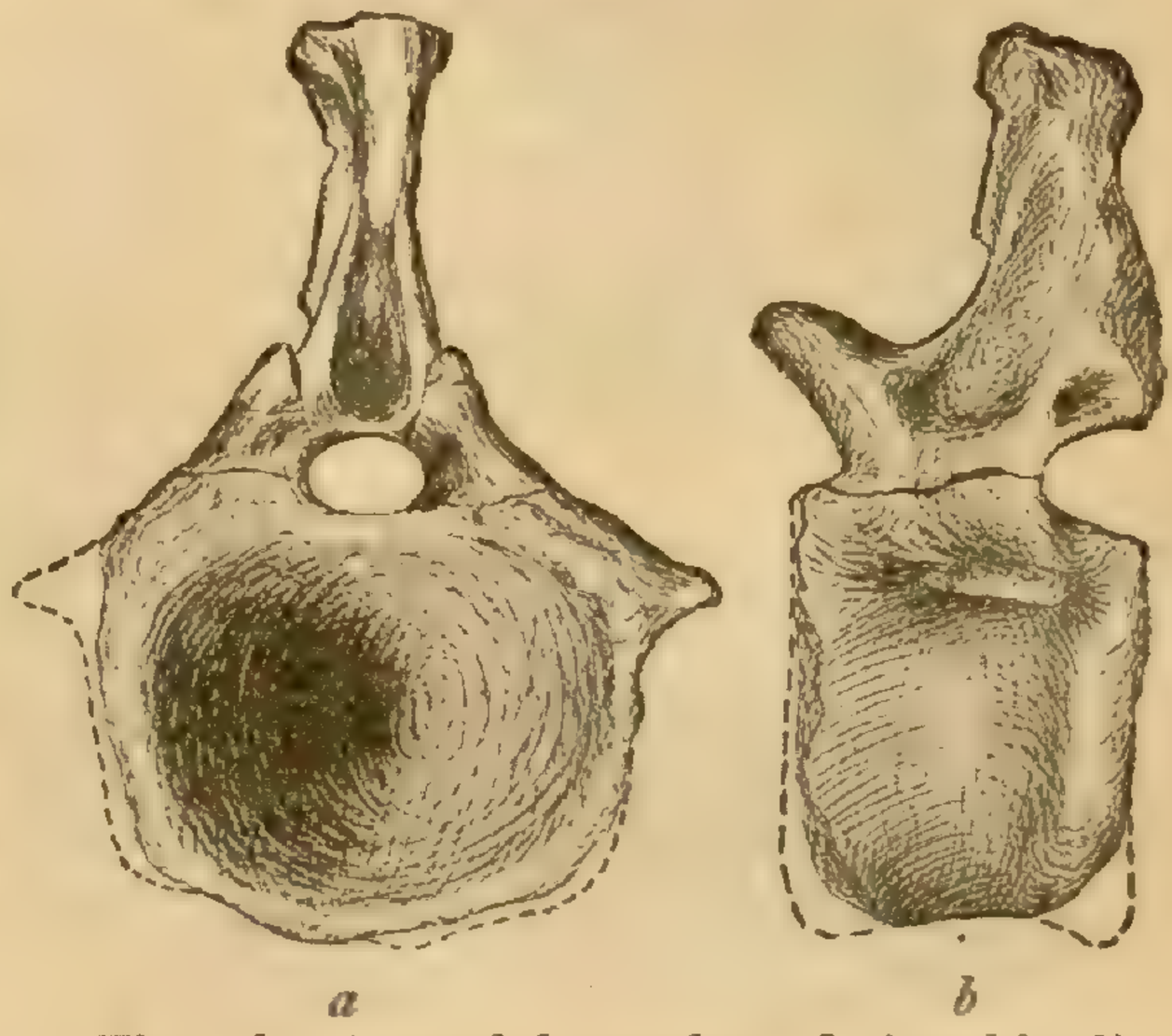


Fig. 17—Left femur of *Amphicœlias latus*, from behind.



a *b*

Fig. 16—A caudal vertebra of *Amphicœlias latus; a* from before, *b* from the left side.

of the dorsal vertebra three feet three inches. The animal, if proportioned anteriorly like the *Camarasaurus supremus*, must have been able to elevate itself to a height of thirty feet. Its length cannot yet be conjectured.

If in this fauna, the *Camarasaurus supremus* was preëminent in general proportions, and the *Amphicœlias altus* was the tallest, the *Amphicœlias latus* was the most robust. It is represented in Mr. Lucas' collection by a right femur and four caudal vertebræ which are in good preservation. They reveal the existence of another saurian of huge dimensions, and of great mass in proportion to its height.

The caudal vertebræ are apparently from the anterior part of the series. They are all strongly biconcave; the anterior face more so than the posterior. They are much more deeply bicon-

cave than those of the *Camarasaurus supremus;* and also differ in their relatively and absolutely greater breadth of body.

The femur is extraordinarily robust. The great trochanter is low, but the shaft is widest where it expands outward. The third trochanter is a ridge, is above the middle, and is short and little prominent. It is on the inner edge of the posterior aspect of the shaft, and looks backwards and inwards. The shaft in its present state is compressed so as to reduce the antero-posterior diameter. It is not however crushed or cracked. The condyles have much greater transverse than antero-posterior extent. They are moderately produced backward, and are separated by a deep popliteal groove, while the anterior trochlear groove is wide and well marked. The inner condyle is narrowed posteriorly, while the external one is obtuse and robust. Their articular faces are marked with irregular pits as in *Dystrophæus* and *Cetiosaurus*.

The length of this bone is fifty inches and the thickness fourteen inches. The body of the caudal vertebra is ten inches in transverse diameter.

The character of the articular surfaces of the bones of the limbs already mentioned is a peculiarity of *Camarasaurus* as well as of the genera named. It indicates a thick cartilaginous cap of the bones, which, if ossified, would be an epiphysis like that of the *Mammalia.* I first observed this character in the *Dystrophæus viæmalæ*, a huge saurian discovered by Prof. J. S. Newberry in the red rocks of the Painted Canyon, near the Sierra La Sal, in south-eastern Utah, and described by myself in Lieut Wheeler's final report. The bed from which it was derived is supposed to be of Triassic or Jurassic age. It had an enormous scapula like *Camarasaurus*, and a long straight humerus; its toes were short. It was probably a predecessor of the gigantic forms from the Dakota formation, and an inhabitant of a more ancient continent. It did not reach the dimensions of either of the species of the genus above-named, or of *Amphicœlias*, having been only as large as an elephant.

The genus *Tichosteus* included a species not larger than an alligator. Its vertebræ were hollow, but the internal chamber did not communicate with the body cavity. The only known species of *Symphyrophus* was of similar size, but the vertebral bodies were solid. Some of the numerous crocodile-like teeth found by Mr. Lucas probably belong to species of these genera.

Dr. Hayden visited the locality of Mr. Lucas' excavations, and informs me that the formation from which the *Camarasaurus* was obtained, is the Dakota. Prof. Marsh has attempted to identify what is, according to Prof. Mudge, the same horizon, one hundred miles north of Canyon City, with the Wealden of England. Specimens from the northern locality which I have examined render it certain that the horizon is that of Mr. Lucas' excavations. Of this I may say that there is no palæontological evidence of its identity with the Wealden. The resemblance of the vertebrate fossils to those of the English Oolite is much greater, but not sufficient as yet for identification.

The discovery of *Vertebrata* in the strata of the Dakota epoch is an important addition to the geology and palæontology of North America. Credit is due to Superintendent O. W. Lucas for this discovery, and also in an especial manner for the skill and care he has exercised in taking out and shipping the ponderous specimens.

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THE DISCOLORED WATERS OF THE GULF OF CALIFORNIA.

BY THOS. H. STREETS, M.D., U. S. N.

ONE of the earliest names given by the old Spanish navigators to the body of water that lies between the peninsula of Lower California and the western coast of Northern Mexico was the Vermilion sea. It was also known in the earlier times as the Mar de Cortez, and Mar Laurentano; or the Mar Vermiglion, Mar Rojo, and Mar Vermijo, on account of the reddish color of its waters; and more recently as the Mar, or Gulfo, de California.

The names Vermiglion, Vermijo, and Rojo seem to have been applied as early as between the years 1537 and 1540, after the explorations of Ulloa and Alarcon, and from the accounts given of it by Nuño de Guzman and his officers, who were the conquerors and rulers of Sinaloa, a state bordering on the gulf.

In all these narratives, however, it is well to note that two entirely distinct causes of discoloration are confounded. Father Consag and Ugarte, in particular, speak of the brick-colored corrosive water of the gulf-head, which is altogether different from the more vermilion-colored patches at the mouth of the gulf, which were, doubtless, what suggested the name Vermilion sea.

J. Ross Browne, at a recent date, and before him De Mofras, discredited the statements of the old Spanish sailors, and attributed the red color to the reflection in the water of the brilliant, rosy-tinted clouds of sunset.

We had ample opportunity to verify the truth of the Spanish account during the extended survey of the gulf and its shores by the U. S. Steamer "*Narragansett*," in 1875.

We first saw patches of the red water south of Ciralbo island. The steamer was stopped and a bucket was thrown overboard to secure some of it for examination. The water thus procured revealed nothing when subjected to the test of the microscope; it was perfectly transparent. The failure to discover the cause in this instance was due to the fact that the coloring matter does not float upon the top of the water, but is suspended several feet below; and when this was ascertained, by putting a lead in the bucket and sinking it a half fathom or more below the surface, there was no difficulty in obtaining all that was desired.

When first drawn up and viewed in a glass vessel by the unaided eye the water had a faint reddish tinge. When allowed to stand for a half hour the coloring matter settled to the bottom of the vessel as a greenish-yellow precipitate; and when some of this was taken up by a pipette and examined under the microscope, it was seen to be composed of minute roundish bodies. Further on these were proven to be the remains of ciliate infusoria.

The latter fact was not discovered, however, until after much painstaking investigation. Some small objects had been seen repeatedly to dart across the field of vision when the water was placed fresh upon the glass slide, but they disappeared as they came, like a flash, and it was a long time before their disappearance could be satisfactorily accounted for. The molecules were the only bodies that were permanent, and I was inclined to attribute to them the phenomenon of the water. Finally, one of the little bodies mentioned above stopped directly in the centre of the field of vision, and commenced a rapid rotatory movement, which presently ceased, and the animal was quiescent for a second or two; when lo! a rupture occurred, its molecular contents oozed out, and its transparent envelope became invisible. This then was the solution of the mystery. Afterwards, knowing what to search for, there was no difficulty in seeing the same process repeated again and again.

Mr. Darwin in his "Naturalist's Voyage Around the World," encountered a patch of similarly discolored water off the coast of Peru. According to his account, the water when examined by the microscope was "seen to swarm with minute animalculæ darting about and often exploding. Their shape is oval and contracted in the middle by a ring of vibrating curved cilia. It was, however, very difficult to examine them with care, for almost the instant motion ceased, even while crossing the field of vision, their bodies burst." From the foregoing it is evident that the water of the two localities is discolored alike by the same cause.

Those from the Gulf of California exhibited the same rapid to and fro motion as the ones seen by Darwin, and this motion was succeeded by a rotatory movement on the longer axis. Sometimes the rupture took place as soon as the latter motion ceased, and at other times the animal was motionless for a few moments preceding its final dissolution; and it was during these intervals of quiescence, only now and then observed, that anything like a correct impression of its general outline and structure could be gained. The following is the result of numerous observations extending over considerable time. The animal is oval in outline, with a projecting lip at its broad extremity, fringed with cilia. The rotatory movement took place around the smaller end as a pivot, and it advanced the same end in its to and fro movements. The envelope is a transparent and, apparently, structureless membrane, and in its interior are greenish-yellow granules, or bodies with dark rims and bright centres. These bodies floated loosely in the cavity of the animal, for when it revolved they changed their places like pebbles in a revolving cask. They averaged about the 1–12000 of an inch in diameter.

According to Mr. Darwin the bursting, which generally occurred at the extremities of the body, is due to an expansion of the tegumentary covering. I can not reconcile this with the results of my own observations. On the contrary, I noticed a contraction to take place in the transverse axis of the body; its length was increased and its transverse diameter diminished; in other words, the oval form was replaced by an oblong. This will better illustrate why the rupture generally took place at one of the extremities of the body. If these observations are correct the bursting of the envelope would be the result of an active rather than a passive action. The only reasonable way of accounting for an

expansion of the body-covering would be by an imbibition of water from the outside, and a rupture would as likely occur in one place as in another in such a case.

When confined in a drop of water, or in an animalcula cage, the little animals never lived as long as a minute, the field of vision was often strewn with their remains before the observer had time to look through the tube of the microscope. This was especially the case if some time had elapsed since their removal from the sea. When kept in a bucket or in any vessel containing a large quantity of water they lived for a much longer time.

Many experiments were made with destructive agents with the view of killing the animalculæ before they had time to destroy themselves, but the results were unsatisfactory. In every instance they failed to accomplish the end for which they were used; if they served any purpose it was to accelerate the process of self-destruction.

The only explanation that I can give for this suicidal propensity lies in the abstraction of oxygen from the water; yet this appears somewhat exceptional in view of the fact that this gas is rather immaterial to the existence of the low, structureless forms of animal life. The bacteria, for instance, will flourish in infusions that have been boiled and hermetically sealed.

We have a record of these minute animals having been in this locality for more than three hundred years, defying the combined action of the winds, waves, and currents, and remaining as closely aggregated as a community of individuals endowed with reason or instinct, and not exposed to dispersing causes. They apparently have great control over their movements, at least so far as regards the fixity of their positions.

The great Colorado River, at the head of the gulf, constantly pours into it an immense volume of water which has a tendency to carry things seaward, as it does logs and other drift; yet here is this microscopic animal, the 1-1000 of an inch long, exposed to the same influence, but remaining in its chosen locality for centuries. What keeps these masses together forever in one place in spite of the circulation of the waters on the surface of the earth? Well might the question have presented itself to the mind of Darwin, but his fertile imagination suggested no adequate solution for it.

Other patches of discolored water obey the same impulse. In

1835 Mr. Darwin investigated that off the coast of Peru. The earliest notice we have of its existence in that locality is the beginning of the nineteenth century, and a good authority might be cited for its existence there as late as 1872. In the latter year while sailing down the eastern coast of South America we passed through a tract, while off the mouth of the Rio de la Plata, where the surface of the water was covered with a thick scum, resembling saw-dust. Darwin, in 1832, or forty years previous, found it further north, in the vicinity of the Abrolhos Islets. In this case the material that discolors the water belongs to the vegetable kingdom. It is a "minute cylindrical conferva," the *Trichodesmium erythræum.* According to Ehrenberg, the color of the water of the Red Sea is due to the presence of a "peculiar genus of alga," and Darwin states, on another authority, that it is the same species as that found off the coast of Brazil. In the latter locality it would certainly argue a defect of the vision to call the water red. Old sailors call it whales' feed, which, with them, is the generic title of everything that discolors the water of the ocean.

"The brick-colored and corrosive waters of certain parts of the gulf-head" received an easier solution at our hands than the more vermilion patches of the mouth of the gulf. The former is spoken of as being so extremely caustic as to remove the skin from the body like a blister, and to cause obstinate boils and ulcers, similar to those produced by scurvy, and which lasted for a long time. Some have gone so far as to even state that it would rot the clothes of those who were incautious in meddling with it. A recent compiler has endeavored to account for this peculiar property of the water on the supposition of an "excess of the iodides, bromides and sulphurets of minerals, derived, doubtless, from the abundance of volcanic material so common in these portions of the gulf." But as is common in such cases of explanatory guessing, his answer is not the true one.

Most of our information concerning this water has come down to us with the accounts of the voyages of Father Consag and Ugarte, both of whom confined their explorations, in these parts, to the head waters of the gulf; the former in 1746, and the latter in 1721.

We encountered this peculiar caustic water in about the same locality assigned it by Consag and others. In the Bay of Muleje, an indentation in the coast more than half way up the peninsula,

the whole surface of the water was of a milky-red color. The body that gives to this water the strangely caustic properties is not a mineral, but an animal—a flagellate infusorium—the common *Noctiluca miliaris.* In this well-sheltered bay they accumulate from their light specific gravity at the top of the water. How thick the stratum was we did not ascertain, but we may form some idea of its extent from the fact that we steamed through the tract in a straight line for four or five hours at a speed of about five knots per hour. We dipped a canvas bucket in their midst, and when the water drained off it remained half filled with the animalculæ. They resemble minute grains of boiled sago. Every drop of water was literally crowded with them. They were so small that it required two or three to cover the area of a pin's head. It is very easy to comprehend how, if this bay were agitated by the slightest cause, it would glow as a broad sheet of living fire.

The Spanish sailors bathed in this water, and according to their chroniclers their bodies were covered with boils and ulcers in consequence. They were only half-way right when they attributed their infirmities to the water. The lashes of the little *noctiluca* were, undoubtedly, the exciting agents—the direct cause of their troubles; but that they were insufficient, in themselves, to account for the severity of the symptoms the evidence of our own men under different conditions of bodily health sufficiently proves. That their ulcers were similar to the effects of scurvy they recognized; and that a scorbutic condition of the blood played an important part in their production is evident. All sailors in those days were more or less the subjects of scurvy, which was a greater obstacle to the spread of commerce than were the small crafts of the navigators. It is a disease that often manifests itself in the form of boils and ulcers, and it exaggerates all trivial bruises and injuries of the skin. If our own sailors had been scorbutic when they bathed in the water the same train of symptoms would undoubtedly have followed; and, as it was, the skin, in places, became considerably inflamed and swollen, but the only disagreeable symptoms were the burning and tingling that accompanied the inflammation, which was of short duration.

NOTES ON THE DISTRIBUTION OF TIMBER IN SOUTH-WESTERN IOWA, WITH INFERENCES CONCERNING THE ORIGIN OF PRAIRIES.[1]

BY PROF. J. E. TODD.

UPON the bluff deposit of Western Iowa is found an unusually favorable field for testing the theories concerning the much-vexed question of the origin of prairies, or rather the origin of forests, for doubtless the former are necessarily the older conditions of most regions.

The soil over wide areas is almost perfectly uniform, and so deep that no underlying formation can thrust in its influence to complicate the problem. The surface is almost infinitely varied; the high plain which is the summit of the loess, the low alluvial plains and hill-sides and bluff-sides presenting every conceivable angle of inclination, and dipping in every possible direction. To produce even greater variety, ledges of rock and knolls of gravel occasionally appear.

I.

In such a region timber occurs in the following circumstances:

(1.) In the hill-regions where the slopes are inclined from 5° to 10°, it is found much the most generally on the northern slopes just south of creeks flowing east or west. This was noted some years since, by Mr. J. A. Allen.

Timber is found in the same region a little less frequently on western slopes, east of creeks flowing north or south. On the same streams considerable timber may occasionally be found on the west side. All other portions of the hill region are uniformly destitute of trees.

(2.) In the bluff region, where the slopes are from 10° to 45°, just east of the bottom lands of the Missouri river, timber is found over most of the surface, forming a belt from one to five miles in width, in Fremont county, and extending northward through Mills and Pottawattamie counties, with a narrowing and more interrupted course till it fades out in Harrison county. This belt is usually bounded on the west by the crest of the most western ridge of bluffs, leaving the slopes facing the bottom land bare, except in two well-marked cases; the first, when a lake,

[1] Read before the Iowa Academy of Science, September 26, 1877.

slough or stream comes close to the base of the bluffs; the second, when the bluff-side is deeply furrowed with ravines. In the former case the slopes are covered with bushes and scrub-oaks, often quite to the top. In the latter, the ravines are wooded, usually with the trees extending considerably higher on the south side than upon the north, and often the latter is scarcely wooded at all. These points are very evident to one riding over the bottom lands so far away as to get a general view.

(3.) In the low alluvial valleys, the timber is found along the streams, usually in narrow strips, widening to fill the bends, and usually wider on the east and north sides of the stream. All other portions of the bottom lands are remarkably destitute of trees and bushes.

II.

The timbered areas are very constant, increasing very slowly if at all. This is indicated by the existence of old trees, over two hundred years old, within four or five rods of prairie, and the prairie showing no signs of having been previously timbered. Some of these cases were on the north side of groves, which side is most exposed to prairie fires, as the north-west wind usually prevails when the prairies are burning. Moreover after a personal acquaintance for the past twenty-five years with numerous localities in this region where the annual fires have been kept out, the writer has not yet learned of a single case where the advance of the timber has been more than five rods, and in the great majority of cases it has not been as many feet. He has not noted any cases of any destruction of timber by prairie fires except on the bottom lands, where the grass is much more rank and the timber is not protected by outlying hazel thickets as upon the upland.

Almost the only gain of timber land is due to seeds of the cotton-wood and willow finding lodgment on the bare surface of sand bars, "break offs," and where freshets break the turf, or cover it with a layer of bare earth. From such beginnings sometimes thrifty groves result, but quite as frequently the trees so started barely hold their own against their herbaceous foes, if not assisted by the favoring hand of man. In the slow advance of groves before alluded to, the *Rhus glabra* takes the front rank, and the hazel follows, preparing the way for elms, hickories, etc.

III.

These are the observed facts; what is their bearing on some of the theories advanced by different writers?

(1.) We find in Dr. White's report on the Geology of Iowa, Vol. 1, page 133, these words: "It now remains to say without the least hesitation that *the real cause of the present existence of the prairies in Iowa is the prevalence of annual fires.* If these had been prevented fifty years ago, Iowa would now be a timbered, instead of a prairie state. This view was fully endorsed by his assistant, Professor St. John. Although the distribution of trees as given above may seem to favor this theory, when we remember that fires occur mainly while the north-west winds prevail, and though it may be a slight factor in the problem, yet its inadequacy is clearly proved, not only by the constancy of timber areas whether the fires burn or not, but also indirectly, by their failing to make prairies of Ohio and New York, when the principle is made of general application. Dr. Newberry from a general survey of the subject, pronounces the idea "simply puerile" (Geology of Ohio, Vol. 1, page 30).

(2.) Professor J. D. Whitney has recently taken pains to reiterate his theory published some years ago, viz: that the cause of prairies, at least in states east of the Missouri river, is mainly in the fineness and depth of the soil, which he further ascribes to the nature and position of the rocks underlying. This theory is sufficiently disproved by the observations given above. In exactly the same soil totally different results are discovered.

(3.) The theory that the absence of trees is mainly dependent on the rain-fall, as is very generally held, is also proved to be faulty, if not false, for there is every reason to believe the rain-fall the same over most of the area under consideration. There may be an excess in the main bottom lands, but surely not on either side of the same ravine or hollow. This theory is also disproved most clearly by Professor Whitney in his article in the AMERICAN NATURALIST (October, 1876), in which he shows from Smithsonian rain-charts that the forest region of several States receives the least rain-fall, and the prairie region the greatest.

(4.) The theory advocated, as we understand, by Colonel J. W. Foster, and more recently by Dr. Newberry (Geology of Ohio, Vol. 1, page 30), is, that forests to flourish need "not so much a profuse as a constant supply of water," that a *deficiency* of *winter*

rains and snow with "occasional though rare seasons of excessive dryness" characterize the prairie regions. This seems to come nearer explaining general facts, but though the underlying cause may be correct, viz: *constant moisture*, the means by which it is secured is certainly not that needed to explain the particular cases before us, for both timber and prairie, in the region under consideration, has, as before stated, the same rains and the same droughts.

IV.

From these theories, then, we have found nothing helpful for solving our problems, unless it be the idea of the *constancy of moisture.* Furthermore it seems quite clear that there is nothing very variable in the region observed, except the surface of the land and the distribution of streams. Can these factors secure the constancy of moisture required, in the circumstances where we have found trees, and the lack of such constancy where we do not find them? Let us see.

(1.) This constancy of moisture must be in one or both the *media*, in which the trees are located, viz: the soil and the air, and it is reasonable to presume that this constancy is to be looked for when the forces of vegetable life are in activity. Excess or lack of moisture at other times may be safely ignored.

(2.) We can readily see that moisture of the soil will be more constant on northern slopes than southern, because they are not so much exposed to the sun's heat. In spring they are many days later in drying up, so also after showers, and at certain degrees of humidity of the air, the northern slope may act as a *condenser*, thus collecting the moisture, which the opposite hill-side is giving off. These processes also affect the air, tending to secure a greater constancy on the northern slope. Moreover the same slope would be more protected, by its position, from the summer south wind, which occasionally is very hot and dry. These considerations may sufficiently account for the timber occurring on northern slopes and for its absence, in general, from southern slopes.

(3.) The prevailing winds of the region are westerly in spring and summer. This perhaps may sufficiently explain the preponderance of timber areas on the east side of streams flowing south, especially where the streams are of considerable size, and affording better opportunity for evaporation. This

combined with the increased roughness of the surface of the country, may also go far toward explaining the timber belt observed in the bluff region. This becomes more obvious when we remember that the east side of the Missouri bottom lands, in the particular counties through which the timber belt passes, abound in sloughs and lakes, which are kept well filled by numerous springs and small streams, which fail to make their way across the bottom land to the river.

These causes also explain the occurrence of timber on the west face of the bluffs, where the moisture in the air counteracts the severe drainage of the abrupt slope and the intense drying action of the afternoon sun, which render other portions of the bluff-face almost destitute of even grass.

(4.) It remains to explain, if possible, the distribution of timber and prairie in the alluvial valleys or bottom lands. Here we have usually a slightly different soil, layers of clay preventing the ready drainage of many parts. These conditions render much of the surface too wet at all times, while other places are too wet in spring and too dry in late summer. These areas are found mostly in the eastern portion of the Missouri river bottom, because the surface there is lower and receives the water from springs and freshets from the bluff-region. The occurrence of trees along the streams and on ridges along old channels, on the other hand, may be explained partially by the inequality of surface, making the drainage of surplus water possible, so that moisture around the roots is more constant than elsewhere on the bottoms. The prairie fires, moreover, have been more efficient over the dryer portions of the bottom lands than elsewhere, because of the greater growth of grass and the free sweep for winds north and south.

V.

That the *constancy of the humidity of air and soil* is the most important factor in the formation of forests seems supported by further considerations taken from a wider field, which may be briefly indicated as follows: This theory explains the timber in areas of less rain-fall in northern Michigan and Wisconsin by their being traversed by moist winds, and not as subject to the hot rays of the sun as the southern portions of the same states. It explains the occurrence of timber upon mountains by a substitution of altitude for latitude in the preceding cases. It

explains the distribution of timber in slightly hilly and level regions like the one under consideration, as has been shown above. It explains the existence of prairies where the rain-fall may be extreme even, for the precipitation of moisture may be caused by extreme changes of temperature, and the changeable climate which may produce much rain may also produce intervals of great dryness. It explains why the timber areas may sometimes correspond to geological formations, as urged by Professor Whitney. The soil either carrying the rain-fall away rapidly or retaining it; either cutting off the surface from the springs of water below, or drawing it up like a sponge; either rendering the climate more uniform by its better conducting power, or allowing the changes of the atmosphere to govern too perfectly the temperature of the surface of the ground. It may explain to some degree the fact that the grass of the prairie prevents the advance of timber in a hilly region by its preventing the showers entering and moistening the roots of larger forms of vegetable life. It also suggests certain means for securing the healthy and continued growth of groves, indicating the more favorable positions for them, showing methods of economizing the rain-fall in places where it may be scanty, etc.

In conclusion, therefore, while acknowledging that prairie fires, the amount and distribution of rain-fall, the nature of the soil, the temperature and inclination of surface, that all may have more or less importance in explaining the origin of forests and prairies; we may nevertheless be convinced that the *fundamental condition of forest growth is a constant medium humidity of air and soil.* Let us, therefore, *while not neglecting our pluviometers look more carefully to our hygrometers* in our study of this subject.

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THE FIELD-WORK OF THE UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, UNDER THE DIRECTION OF PROF. F. V. HAYDEN, FOR THE SEASON OF 1877.

ON the completion of the survey of Colorado last year, it was determined that the work of the United States Geological and Geographical Survey of the Territories, under the direction of Prof. Hayden should continue northward into Wyoming and Idaho. The belt of country including the Pacific Railroad having been explored

and mapped in detail by the Survey of the Fortieth Parallel, under Clarence King, Esq., it was deemed best to commence at the northern line of that work, and continue northward and westward, taking for the season of 1877 the country from Fort Steele, Wyoming Territory, to Ogden, Utah, or, more exactly, from longitude 107° to 112°, and northward to the Yellowstone Park.

The primary-triangulation party, in charge of Mr. A. D. Wilson, chief topographer of the survey, took the field from Rawlins Springs, W. T. Near this point a base-line was measured with great accuracy, from which a net-work of triangles was extended over the country to the north and west, locating at intervals of from twenty to thirty miles, some prominent peaks upon which stone monuments were built, in order that the topographers could recognize the points thus fixed for them. Upon these points was based the system of secondary triangulation.

From the base at Rawlins, the work was carried northward to the Sweetwater mountains, and thence to the Wind River range. Upon some of the more prominent peaks of the latter range, such as Frémont's peak, the stations were made with much difficulty, owing to the great masses of snow found there during the month of June, when the party was working. From this range the work was carried across the Green River basin to the mountains on the west and north, where several stations were made. The work was resumed to the west as far as Fort Hall, Idaho, and thence south to the vicinity of Bear lake, where another base, or base of verification, was measured; thence south as far as Ogden and Evanston, connecting with the triangulation of the Fortieth Parallel Survey at these points. From Evanston the party marched eastward, making some stations north of the railroad, thus bringing the work back to the point of beginning, Rawlins Springs, where the party was disbanded for the season.

The area assigned to the Green River division, under the direction of Mr. Henry Gannett, was rectangle No. 56, which is limited on the east and west by the meridians of 109° 30′ and 112°, and on the north and south by the parallels of 43° and 41° 45′. This is an area of about 11,000 square miles, lying in parts of Wyoming, Utah and Idaho. The party took the field at Green River city, Wyoming, on June 1st. They first surveyed the drainage of Green River basin. For this purpose they travelled up the Big

Sandy, a large eastern branch of the Green, to the foot of the Wind River mountains; thence crossing the head of the basin, fording the large and rapidly rising streams which make up the New Fork of the Green, they reached the main Green, and traveled down its western bank, going in to Granger, Wyoming, on the Union Pacific Railroad, for supplies on June 23d.

' The party left the field at Ogden, Utah, on September 30th, having been in the field just four months. The area surveyed was between 12,000 and 13,000 square miles; 347 stations and locations were made, 53 of the stations being important ones, were marked with stone monuments for future reference.

The geological work of Dr. A. C. Peale in the Green River district connected directly with the western edge of the Sweetwater district. With the exception of a small area of granite along the south-western side of the Wind River mountains, and some basaltic flows in the north-western portion of the district, the rocks are sedimentary, including the rocks from the Silurian to very late Tertiary age.

The first month of the season was occupied mainly with the survey of the Green River basin.

The next area taken up was that lying between Green river and the Bear, with a strip along the northern edge of the district, reaching westward beyond Fort Hall.

The Blackfoot, Portneuf, and Bear all have basalt in their valleys. On the Portneuf it extends almost to the Snake River plain, appearing as a narrow belt. Its surface slopes, but not so much as the present bed of the stream. In some places the volcanic rock appears to have pushed the river to the western side of the valley. The lower valley of the Portneuf is interesting from the fact that it is the probable ancient outlet of the great lake that once filled the Salt Lake basin. At the head of Marsh creek, which occupies the valley, continuing directly south from that of the Lower Portneuf, is the lowest pass between the Great Basin and the drainage of the Columbia. In fact, so low and flat is it that a marsh directly connects the two streams, one flowing to the Bear and the other to the Portneuf and Snake rivers.

The bend of Bear river at Soda springs is one of the most remarkable features of the whole district. Rising in the Uintah mountains, Bear river flows northward for over two hundred miles, and at Soda springs bends abruptly and flows southward

toward Salt lake. After it emerges from the gap west of Soda springs, it flows out into a wide valley which opens directly into that of the Upper Portneuf. In this valley the divide between the two rivers is only a basalt plain, and in the eruption of this lava we may look for the clew to the extraordinary course of Bear river.

The latter half of the season was devoted to Bear river, Bear lake, and Cache and Malade valleys.

There is but little doubt that the waters which once filled the Salt Lake basin covered also the broad Cache valley. The modern tertiary deposits are found jutting against the mountains, and seem to pass gradually into the more recent deposits found in the central portion of the valley. The clays, sands and marls of these modern beds are beautifully exposed along Bear river, which cuts its way across the north-western part of the valley. On the west the mountains are broken or isolated ranges, which seem to have risen above the waters of the old lake as islands. The terraces are well marked on their sides, connecting with the Salt Lake valley through the gap of Bear river.

West of this gap, and extending northward, is the Malade valley. It is broad and filled with modern lake deposits. Silurian rocks outcrop on the east and Carboniferous on the west. At the divide between the Malade and Marsh creek is another of the old outlets of the ancient Salt lake when its waters were at the highest level. Although the area surveyed was large (13,000 square miles), good collections of fossils were made and data obtained for the elucidation of many interesting problems in relation to the age of the mountains.

Dr. F. M. Endlich, geologist of the Sweetwater divison, states that within the area described above he found a well diversified country. A portion of the Wind River mountains in the north-west corner, the Sweetwater and Seminole hills toward the eastward, in addition to the lower bluff-country in the southern portion, furnished material at once full of interest to the student and to the surveyor.

On July 5th the party left Stambaugh and marched toward the low valleys belonging to the Wind River drainage. The difference in elevation amounted to about 3,000 feet, and the temperature of the atmosphere was consequently much higher. With the change of elevation the geological formations change. Instead of the youngest

beds resting directly upon metamorphics, we now find a full series of the sedimentary formations, beginning with the Silurian. Numerous interesting stratigraphical phenomena were observed and studied with a view to determine their relations to the main mountain-chain. An ample amount of evidence has been obtained, more particularly by this means, to speak positively respecting the geological age of the Wind River mountains. These latter, in this region, form the main Rocky Mountain chain, and the determination of their age will necessarily throw much light upon the same question arising in other portions of the same range. It will be possible to speak with a certain degree of precision of either the local, varying (as to time) elevation of the mountains or to refer it to one particular epoch for the distance of many hundreds of miles.

Camp Brown is located in the valley of the Little Wind river, which there is of considerable breadth. The famous hot springs there were examined. As the main peaks of the Wind River mountains were mostly inaccessible from the east side, it was deemed advisable to make the ascents of the highest from the west. Therefore the party traveled along the eastern foot-hills, through a very rugged country, until Stambaugh was reached.

July 22d the party again left Stambaugh and marched along the headwaters first of Sweetwater river and then of the eastern tributaries of Green river. Several of the highest peaks were ascended, and the greatest altitude reached found to be about 13,700 feet. This latter was on what the settlers generally designate as Frémont's Peak. From careful comparison of Frémont's report with the observations made by the party, it is evident that a misapplication of the name has been made, and that the peak in question is not the one ascended by that intrepid explorer of an "early day."

Having reached the northern limit of the district, the route was reversed and the western foot-hills of the main ranges examined. Here, as well as in the mountains proper, were noticed the remains of enormous ancient glaciers. Moraines, covering many square miles, often a thousand feet in thickness, extend downward through narrow valleys, now containing rushing streams. Striation, grooving and mirror-like polish of rock *in situ* denote the course taken by the moving ice-fields that have left these marks of their former existence. From all appearance the cessa-

tion of glacial activity must have occurred within a comparatively recent time. Scarcely any vegetation has sprung up on the light glacial soil, and the characteristic distribution of erratic material bears every evidence of freshness. Considering the enormous amount of snow and ice that was observed by the party exploring (latter part of July and beginning of August), the view was expressed by the geologist that the discovery of still active glaciers in that range would by no means be surprising.

Returning for the last time to Stambaugh, the route was taken in an easterly direction along the Sweetwater and its drainage. First, the adjacent drainage of the Wind river was surveyed, and the divide between the two streams crossed. All along the Sweetwater the characteristic "Sweetwater group" of tertiary age was found to occur. It has been named and described in my former publications. This continued uninterruptedly until a series of hills north of the river opposite Seminole Pass, was reached. These consist merely in projections of granite that during the tertiary epoch, and probably long before that, had remained as islands above a widely-extended sea. Apart from their singularly unique character in this respect, the granite itself possesses a peculiarity that renders it at once conspicuous. Owing to the distribution of component minerals this granite is in a high degree subject to exfoliation. Probably the main cause of this may be found in the action of freezing water. The result as observed is striking. Instead of the rugged outlines usually presented by isolated granitic outcrops, we find a series of rounded, smooth, almost totally barren hills. To such an extent is this feature developed that many of them offer serious obstacles to an attempted ascent. A locality where the celebrated moss-agates occurred in great quantities was found in that region, and the geognostic horizon of these interesting quartz varieties was established.

The district assigned to the Teton division, directed by Mr. G. R. Bechler, was situated between the parallels 43° and 44° 15′ of north latitude and the meridians 109° and 112° of west longitude. This area is drained by the branches of Shoshone or Snake river. The first portion surveyed by this division lies along the Blackfoot river and its tributaries.

After having completed the area described above, Mr. Bechler returned to Fort Hall for supplies, and then passed up Henry's

Fork to the northern portion of the Teton mountains, where he spent several weeks investigating this snow-covered range; then, crossing Pierre's basin, surveyed the lofty group to which in 1872 he gave the name of Pierre's Hole mountains. These ranges are characterized by as great ruggedness and inaccessibility as any other mountains in the north-west.

Fronting the Grosventre range on the north rises another mountain cluster, separated from the former by the Grosventre river. This range forms the divide between the latter river and the Buffalo Fork of the Snake. It connects with the main Rocky mountains near the sources of Wind and Gosventre rivers and the Buffalo Fork of the Snake, and culminates near its western end in Mount Leidy. Mr. Bechler occupied two weeks in a careful survey of a part of the Grosventre range, the entire Mount Leidy group, with the Upper Snake River valley and its numerous interesting features.

North of the Buffalo Fork of the Snake, his observations extended into that densely wooded mountain region which connects to the north with the Mount Sheridan group near the Yellowstone, Lewis and Shoshone lakes.

About the 1st of September he left the waters of Snake river and marched along the rugged and densely timbered mountain spurs toward the Upper Wind River pass, and, after crossing the latter, entered Wind River valley, having the Owl mountains on the left and the Wind River range on the right. As he was about to cross over the Warm Spring pass of the Wind River mountains into the Green River valley to survey the southern ends of the Grosventre and Salt River ranges, he received a notice through Indian scouts, from the commander of the military post at Camp Brown, to leave the country on account of the danger of hostile Indians. On this account nearly a month of valuable time was lost, abridging somewhat the results of the season's work. Notwithstanding the various difficulties which this party encountered, they surveyed an area of about 6,000 square miles of the most rugged mountain country in the north-west, and made one hundred and ten reliable observations with the mercurial barometer. Mr. Bechler, throughout his district, personally observed 7,340 horizontal angles and 5,700 angles of elevation and depression; they repeated backward and forward, and were checked by good barometric observations.

Mr. Orestes St. John, geologist of the Teton division, entering the field assigned to the Teton division of the survey at its southwestern corner, the first five weeks were devoted to the examination of the region lying in the great northern bend of the Snake river, and which includes an area of 1,700 to 2,000 square miles.

The Blackfoot mountains are mainly composed of Carboniferous strata, which mainly represent the earlier period, whose epochs are indicated by similar palæontological peculiarities which distinguish the Lower Carboniferous formations in the Mississippi basin, and which more extended research will doubtless reveal in this distant region. But one of the most interesting discoveries in this connection was the presence of fish-remains, representing several forms identical with or closely allied to Keokuk species of the genera *Cladodus*, *Petalodus*, *Antliodus*, *Helodus*.

Dr. White, the palæontologist of the survey, has shown the identity of the lignitic series of strata east of the Rocky mountains in Colorado with the Fort Union group of the Upper Missouri river, and also its identity with the great Laramie group of the Green River basin and other portions of the region west of the Rocky mountains. He also finds the planes of demarkation between any of the Mesozoic and Cenozoic groups, from the Dakota to the Bridger inclusive, to be either very obscure or indefinable; showing that whatever catastrophal or secular changes took place elsewhere during all that time, sedimentation was probably continuous in what is now that part of the continent from the earliest to the latest of the epochs just named. Other results and further details of the season's work will appear in the following paragraphs.

The general course of travel pursued by Dr. White during the season was as follows, not including the numerous detours, meanderings and side trips which the work necessitated: Outfitting at Cheyenne, he journeyed southward, traversing in various directions a portion of the great plains which lie immediately adjacent to the eastern base of the Rocky mountains in Colorado. The most easterly point thus reached was some sixty miles east of the base of the mountains and the most southerly point about twenty-five miles south of Denver. Returning to Denver to renew his outfit, he crossed the Rocky mountains by way of Boulder pass through Middle park. After making certain com-

parative examinations of the Mesozoic and Cenozoic formations in Middle park he proceeded westward to the headwaters of the Yampa river, following that stream down to the western foot-hills of the Park range of mountains.

Here resuming his comparative examinations of the Mesozoic and Cenozoic strata, he passed down the valley of the Yampa as far as Yampa mountain, one of those peculiar and remarkable upthrusts of Palæozoic rocks through Mesozoic strata. In all this area, as well as that between the Yampa and White rivers, the Laramie group reaches a very great and characteristic development, and it received careful investigation, yielding some of the most important results of the season's work. Crossing the ground between the two rivers named to White River Indian agency, thence down White River valley about one hundred miles; thence to Green river, crossing it at the southern base of the Uintah mountains, making many detours on the way, he reviewed the geology of the region which he had surveyed during the previous season. This review brought out not only the important palæontological facts before referred to, but it also added materially to the elucidation of the geological structure of the region which lies between the eastern end of the Uintah mountain range on the west and the Park range on the east.

Beyond Green river he pursued his travels westward, studying the Mesozoic and Cenozoic strata that flank the Uintah range upon its south side, and making comparisons of both their lithological and palæontological characteristics.

In this way he traversed the whole length of the Uintah range, crossing at its junction with the Wasatch range over into the valley of Great Salt lake. Recrossing the Wasatch to the north side of the Uintah range he continued his examinations of the Cretaceous and Tertiary strata into and entirely across the great Green River basin, leaving the field at the close of the season at Rawlins station on the Union Pacific railroad.

A general statement of the results of the season's work has been given in a previous paragraph, but the following additional summary will make the statement somewhat clearer, being made after the route of the season's travel had been indicated. The formations of later Mesozoic and earlier Cenozoic ages, especially those to which Dr. White in former publications, has applied the provisional designation of "Post-Cretaceous," have received par-

ticular attention. The extensive explorations of Dr. Hayden in former years, and the palæontological investigations of the late Mr. Meek, pointed strongly to the equivalency of the Fort Union beds of the Upper Missouri river with the lignitic formation as it exists along the base of the Rocky mountains in Colorado, and also to the equivalency of the latter with the Bitter Creek series west of the Rocky mountains. The investigations of this year have fully confirmed these views by the discovery not merely of one or two doubtful species common to the strata of each of these regions, but by an identical molluscan fauna ranging through the whole series in each of the regions named.

This shows that the strata just referred to all belong to one well-marked period of geological time, to the strata of which Mr. King has applied the name of "Laramie group" (Point of Rocks group of Powell). His investigations also show that the strata, which in former reports by himself and Professor Powell have been referred to the base of the Wasatch group, also belong to the Laramie group and not to the Wasatch. He has reached this later conclusion not merely because there is a similarity of type in the fossils obtained from the various strata of the Laramie group with those that were before in question, but by the specific identity of many fossils that range from the base of the Laramie group up into and through the strata that were formerly referred to the base of the Wasatch. Furthermore, some of these species are found in the Laramie strata on both sides of the Rocky mountains. Thus the vertical range of some of these species is no less than three thousand feet, and their present known geographical range more than a thousand miles.

Besides the recognition of the unity of the widely-distributed members of the formation of this great geological period, bounded by those of undoubted Cretaceous age below and those of equally undoubted Tertiary age above, his further observations have left comparatively little doubt that the "Lake Beds" of Dr. Hayden, as seen in Middle Park, the "Brown's Park group" of Professor Powell, and the "Uintah group" of Mr. King, all belong to one and the same epoch, later than and distinctly separate from the Bridger group.

In that portion of the region which lies adjacent to the southern base of the Uintah Mountain range, and which is traversed by Lake fork and the Du Chesne river, not only the Uintah group,

but both the Green River and Bridger groups also are well developed, each possessing all its peculiar and usual characteristics as seen at the typical localities in the great Green River basin, north of the Uintah mountains. This, added to the known existence of Bridger strata in White River valley, and the extensive area occupied by the Green River group between White and Grand rivers, has added very largely to our knowledge of the southward extension of those formations.

In all the comparative examinations of the formations or groups of strata that have just been indicated, he has paid especial attention to their boundaries, or planes of demarkation, crossing and recrossing them wherever opportunity offered, noting carefully every change of both lithological and palæontological characters. While he has been able to recognize with satisfactory clearness the three principal groups of Cretaceous strata, namely, the Dakota, Colorado, and Fox hills, on both sides of the Rocky and Uintah mountains, respectively, they evidently constitute an unbroken series, so far as their origin by continuous sedimentation is concerned. While each of the groups possesses its own peculiar palæontological characteristics, it is also true that certain species pass beyond the recognized boundaries of each within the series.

The stratigraphical plane of demarkation between the Fox hills, the uppermost of the undoubted Cretaceous groups, and the Laramie group, the so-called Post-Cretaceous, is equally obscure; but the two groups are palæontologically very distinct, inasmuch as the former is of marine origin, while the latter, so far as is now known, contains only brackish-water and fresh-water invertebrate forms. He reports a similar obscurity, or absence of a stratigraphical plane of demarkation, between the Laramie and Wasatch groups, although it is there that the final change from brackish to entirely fresh water took place over that great region. Furthermore, he finds that while the three principal groups of the fresh-water Tertiary series west of the Rocky mountains, namely, the Wasatch, Green river, and Bridger groups, have each peculiar characteristics, and are recognizable with satisfactory distinctness as general divisions, they really constitute a continuous series of strata, not separated by sharply-defined planes of demarkation, either stratigraphical or palæontological.

Messrs. S. H. Scudder, of Cambridge, and F. C. Bowditch, of

Boston, spent two months in Colorado, Wyoming, and Utah, in explorations for fossil insects, and in collecting recent Coleoptera and Orthoptera, especially in the higher regions. They made large collections of recent insects at different points along the railways from Pueblo to Cheyenne and from Cheyenne to Salt Lake, as well as at Lakin, Kans., Garland and Georgetown, Colo. and in various parts of the South Park and surrounding region.

For want of time, they were obliged to forego an anticipated trip to White river, to explore the beds of fossil insects known to exist there. Ten days were spent at Green river and vicinity in examining the Tertiary strata for fossil insects, with but poor results; the Tertiary beds of the South Park yielded but a single determinable insect, but near Florissant the Tertiary basin, described by Dr. A. C. Peale in the annual report of the Survey, for 1873, was found to be exceedingly rich in insects and plants.

In company with Rev. Mr. Lakes, of Golden, Mr. Scudder spent several days in a careful survey of this basin and estimates the insect-bearing shales to have an extent at least fifty times as great as those of the famous locality at Œningen in Southern Bavaria. From six to seven thousand insects and two or three thousand plants have already been received from Florissant, and as many more will be received before the close of the year.

Mr. Scudder was also able to make arrangements in person with parties who have found a new and very interesting locality of Tertiary strata in Wyoming, to send him all the specimens they work out, and he confidently anticipates receiving several thousand insects from them in the course of the coming winter. The specimens from this locality are remarkable for their beauty. There is, therefore, every reason to believe that the Tertiary strata of the Rocky mountain region are richer in remains of fossil insects than any other country in the world, and that within a few months the material at hand for the elaboration of the work on fossil insects, which Mr. Scudder has in preparation for the Survey, will be much larger than was ever before subject to the investigation of a single naturalist.

Prof. Joseph Leidy, the eminent comparative anatomist and microscopist, made his second visit to the West the past season, under the auspices of the Survey. He made a careful exploration of the country about Fort Bridger, Uintah mountains, and the Salt Lake basin, in search of rhizopods. He has been engaged for a long

time on a memoir on this subject, which will eventually form one of the series of the quarto reports of the Survey.

The botany of the Survey was represented the past season by the two great masters of that department, Sir Joseph D. Hooker, director of the Gardens of Kew, England, and president of the Royal Society of London; and Prof. Asa Gray, of Cambridge, Mass. Their examinations extended over a great portion of Colorado, Wyoming, Utah, Nevada, and California. Their investigations into the alpine floras and tree vegetation of the Rocky mountains and Sierra Nevada enabled them to give a clear idea of the relations and influence of the climatic conditions on both sides of the great mountain-ranges.

Sir Joseph Hooker, whose botanical researches embrace the greater part of Europe; the Indies from the bay of Bengal across the Himalayas to Thibet; the Antarctic regions and the southern part of South America, New Zealand, Australia, South Africa, Morocco and Asia Minor, presents in the English periodical "*Nature*," for October 25, an outline of his studies during the season, and this outline when filled out will form a most important report for the eleventh annual report of the Survey. It will be seen at a glance that the report will be of the most comprehensive character, and cannot fail to be of the highest interest to our people. The tree vegetation, and especially the coniferæ, were made special objects of study, and many obscure points were cleared up.

Of a section of the Rocky mountains comprising Colorado, Wyoming, and Utah, Dr. Hooker says:

Such a section of the Rocky mountains must hence contain representatives of three very distinct American floras, each characteristic of immense areas of the continent. There are two temperate and two cold or mountain floras, viz: (1) a prairie flora derived from the eastward; (2) a so-called desert and saline flora derived from the west; (3) a subalpine; and (4) an alpine flora; the two latter of widely different origin, and in one sense proper to the Rocky Mountain ranges.

The principal American regions with which the comparison will have first to be instituted are four. Two of these are in a broad sense humid; one, that of the Atlantic coast, and which extends thence west to the Mississippi river, including the forested shores of that river's western affluents; the other, that of the Pacific side, from the Sierra Nevada to the western ocean; and two inland, that of the northern part of the continent extending to the

Polar regions, and that of the southern part extending through New Mexico to the Cordillera of Mexico proper.

The first and second (Atlantic plus Mississippi and Pacific) regions are traversed by meridional chains of mountains approximately parallel to the Rocky mountains, namely, on the Atlantic side by the various systems often included under the general term Appalachian, which extend from Maine to Georgia, and on the Pacific side by the Sierra Nevada, which bound California on the east. The third and fourth of the regions present a continuation of the Rocky mountains of Colorado and Utah, flanked for a certain distance by an eastern prairie flora extending from the British Possessions to Texas, and a western desert or saline flora, extending from the Snake river to Arizona and Mexico. Thus the Colorado and Utah floras might be expected to contain representatives of all the various vegetations of North America, except the small tropical region of Florida, which is confined to the extreme south-east of the continent.

The most singular botanical feature of North America is unquestionably the marked contrast between its two humid floras, namely, those of the Atlantic plus Mississippi, and the Pacific one; this has been ably illustrated and discussed by Dr. Gray, in various communications to the American Academy of Sciences, and elsewhere, and he has further largely traced the peculiarities of each to their source, thus laying the foundation for all future researches into the botanical geography of North America; but the relations of the dry intermediate region either to these or to the floras of other countries had not been similarly treated, and this we hope that we have now materials for discussing.

Dr. Hooker sums up the results of the joint investigations of Dr. Gray and himself, aided by Dr. Gray's previously intimate knowledge of the elements of the American flora, from the Mississippi to the Pacific coast:

The vegetation of the middle latitudes of the continent resolves itself into three principal meridional floras, incomparably more diverse than those presented by any similar meridians in the Old World, being, in fact, as far as the trees, shrubs, and many genera of herbaceous plants are concerned, absolutely distinct. These are the two humid and the dry intermediate regions above indicated.

Each of these, again, is subdivisible into three, as follows:

1. The Atlantic slope plus Mississippi region, subdivisible into (α) an Atlantic (β), a Mississippi valley, and (γ) an interposed mountain region with a temperate and subalpine flora.

2. The Pacific slope, subdivisible into (α) a very humid, cool, forest-clad coast range; (β) the great, hot, drier Californian valley formed by the San Juan river flowing to the north and the Sacramento river flowing to the south, both into the bay of San Fran-

cisco; and (γ) the Sierra Nevada flora, temperate, subalpine and alpine.

3. The Rocky Mountain region (in its widest sense extending from the Mississippi beyond its forest region to the Sierra Nevada), subdivisible into (α) a prarie flora, (β) a desert or saline flora, (γ) a Rocky Mountain proper flora, temperate, subalpine, and alpine.

As above stated, the difference between the floras of the first and second of these regions is specifically, and to a great extent generically, absolute; not a pine or oak, maple, elm, plane or birch of Eastern America extends to Western, and genera of thirty to fifty species are confined to each. The Rocky Mountain region again, though abundantly distinct from both, has a few elements of the eastern region and still more of the western.

Many interesting facts connected with the origin and distribution of American plants, and the introduction of various types into the three regions, presented themselves to our observation or our minds during our wanderings. Many of these are suggestive of comparative study with the admirable results of Heer's and Lesquereux's investigations into the Pliocene and Miocene plants of the north temperate and frigid zones, and which had already engaged Dr. Gray's attention, as may be found in his various publications. No less interesting are the traces of the influence of a glacial and a warmer period in directing the course of migration of Arctic forms southward, and Mexican forms northward in the continent, and of the effects of the great body of water that occupied the whole saline region during (as it would appear) a glacial period.

Lastly, curious information was obtained respecting the ages of not only the big trees of California, but of equally aged pines and junipers, which are proofs of that duration of existing conditions of climate for which evidence has hitherto been sought rather among fossil than among living organisms.

Up to the year 1874 rumor had been telling many marvelous stories of strange and interesting habitations of a forgotten people, who once occupied the country about the headwaters of the Rio San Juan, but these narrations were so interwoven with romance that but few people placed much reliance upon them. To those well versed in archæology, ruins of an extensive and interesting character were known to exist throughout New Mexico and Arizona, and the various reports of Abert, Johnson, Sitgreaves, Simpson, Whipple, Newberry, and others form our most interesting chapter in ancient American history; but their researches, aside from the meager accounts published by Newberry, throw no light on the marvelous cliff dwellings and towns north of the San Juan. In 1874 the photographic division of the United States Geological

Survey was instructed, in connection with its regular work, to visit and report upon these ruins, and in pursuance of this objeet made a hasty tour of the region about the Mesa Verde and the Sierra el Late, in South-western Colorado, the results of which trip, as expressed by Bancroft, in the Native Races of the Pacific Coast, "although made known to the world only through a three or four days' exploration by a party of three men, are of the greatest importance." A report was made and published, with fourteen illustrations, in the Bulletin of the United States Geological and Geographical Survey of the Territories, second series, No. 1.

The following year the same region was visited by Mr. W. H. Holmes, one of the geologists of the survey, and a careful investigation made of all the ruins. Mr. Jackson, who had made the report the previous year, also revisited this locality, but extended his explorations down the San Juan to the mouth of the De Chelly, and thence to the Moqui villages in North-eastern Arizona. Returning, the country between the Sierra Abajo and La Sal and the La Plata was traversed, and an immense number of very interesting ruins were first brought to the attention of the outside world by the report which was published the following winter by Messrs. Holmes and Jackson, in the Survey, Vol. II., No. 1.

The occasion of the Centennial Exhibition at Philadelphia led to the idea of preparing models of these ruins for the clearer illustration of their peculiarities, four of which were completed in season for the opening of the Exhibition. Since that time not only the number of these interesting models has been increased, but they have been perfected in execution, and faithful delineations have thus been secured of these mysterious remains of an extinct race who once lived within the borders of our western domain.

A visit to the *atelier* of Mr. Jackson, photographer of the Survey, enables one to inspect, in miniature size, the dwellings of the Moqui, and in full size a large collection of the ceramics and implements of those ancient and extinct people of our continent. A study of the models will give a very excellent idea of the ruined dwellings themselves. The first of these models, executed by Mr. Holmes, with whom the idea originated, represents the cliff house of the Mancos Cañon, the exterior dimensions of which are 28 inches in breadth by 46 inches in height, and on a scale of 1.24, or two feet to the inch. This is a two-story building, constructed

of stone, occupying a narrow ledge in the vertical face of the bluff 700 feet above the valley, and 200 feet from the top. It is 24 feet in length and 14 feet in depth, and divided into four rooms on the ground-floor. The beams supporting the second floor are all destroyed. The doorways, serving also as windows, were quite small, only one small aperture in the outer wall facing the valley. The exposed walls were lightly plastered over with clay, and so closely resembled the general surface of the bluff that it becomes exceedingly difficult to distinguish them at a little distance from their surroundings.

The second model of this series was constructed by Mr. Jackson, and represents the large "cave town," in the valley of Rio de Chelly near its junction with the San Juan. This town is located upon a narrow bench, occurring about 80 feet above the base of a perpendicular bluff some 300 feet in height. It is 545 feet in length, about 40 feet at its greatest depth, and shows about 75 apartments on its ground-plan. The left-hand third of the town, as we face it, is overhung some distance by the bluff, protecting the buildings beneath much more perfectly than the others. This is the portion represented by the model. A three-story tower forms the central feature; upon either side are rows of lesser buildings, built one above another upon the sloping floor of rock. Nearly all these buildings are in a fair state of preservation. This model is 37 by 47 inches, outside measurements, and the scale 1.72, or 6 feet to the inch. A "restoration" of the above forms the third in the series, of the same size and scale, and is intended as its name implies, to represent as nearly as possible the original condition of the ruin. In this we see that the approaches were made by ladders and steps hewn in the rock, and that the roofs of one tier of rooms served as a terrace for those back of them, showing a similarity, at least, in their construction to the works of the Pueblos in New Mexico and Arizona. Scattered about over the buildings are miniature representations of the people at their various occupations, with pottery and other domestic utensils.

The "triple-walled tower," at the head of the McElmo, is the subject of the fourth model. It was constructed by Mr. Holmes, and represents, as indicated by its title, a triple-walled tower, situated in the midst of a considerable extent of lesser ruins, probably of dwellings, occupying a low bench bordering the dry wash of the McElmo. The tower is 42 feet in diameter, the wall two feet

thick, and now standing some 12 feet high. The two outer walls inclose a space of about 6 feet in width, which is divided into 14 equally-sized rooms, communicating with one another by small window-like doorways. The next is a "cliff-house" in the valley of the Rio de Chelly. It is about 20 miles above the cave town already spoken of. This is a two-story house, about 20 feet square, occupying a ledge some 75 feet above the valley, and overhung by the bluff. The approach from the valley is by a series of steps hewn in the steep face of the rock; and this method was the one most used by the occupants, although there is a way out to the top of the bluff. This model is 42 inches in height by 24 broad, and is built upon a scale of 1.36.

Téwa, one of the seven Moqui towns in North-eastern Arizona, is a very interesting and instructive model, representing, as it does, one of the most ancient and best authenticated of the dwellings of a people who are supposed to be the descendants of the cliff-dwellers. Téwa is the first of the seven villages forming the province as we approach them from the east, and occupies the summit of a narrow mesa some 600 feet in height and 1,200 yards in length, upon which are also two other somewhat similar villages. The approach is by a circuitous road-way hewn in the perpendicular face of the bluff which surrounds the mesa upon all sides. It is the only approach accessible for animals to the three villages. Other ladder-like stairways are cut in the rock, which are used principally by the water-carriers, for all their springs and reservoirs are at the bottom of the mesa. This village is represented upon a scale of 1 inch to 8 feet, or 1.96. The dimensions of the model are 36 inches in length, 29 inches in width and 14 inches in height.

In the spring of 1877 Mr. Jackson made a tour over much of the northern part of New Mexico, and westward to the Moqui towns in Arizona, and secured materials for a number of very interesting models, illustrating the methods of the Pueblos or town-builders in the construction of their dwellings. Two villages have been selected for immediate construction, as showing the most ancient and best known examples of their peculiar architecture, viz: Taos and Acoma; the one of many-storied, terraced houses, and the other built high up on an impregnable rock. The model of Taos is now completed, the dimensions of which are 42 by 39 inches, and the scale one inch to twenty feet, 1:240.

Of this town Davis says:

It is the best sample of the ancient mode of building. Here are two large houses three or four hundred feet in length, and about one hundred and fifty feet wide at the base. They are situated upon opposite sides of a small creek, and in ancient times are said to have been connected with a bridge. They are five and six stories high, each story receding from the one below it, and thus forming a structure terraced from top to bottom. Each story is divided into numerous little compartments, the outer tier of rooms being lighted by small windows in the sides, while those in the interior of the building are dark, and are principally used as store-rooms. * * * The only means of entrance is through a trap-door in the roof, and you ascend from story to story by means of ladders on the outside, which are drawn up at night.

Their contact with Europeans has modified somewhat their ancient style of buildings, principally in substituting doorways in the walls of their houses for those in the roof. Their modern buildings are rarely over two stories in height, and are not distinguishable from those of their Mexican neighbors. The village is surrounded by an adobe wall, which is first included within the limits of the model, and incloses an area of eleven or twelve acres in extent. Within this limit are four of their *estufas* or secret council-houses. These are circular under-ground apartments, with a narrow opening in the roof, surrounded by a palisade, ladders being used to go in and out.

These models are first carefully built up in clay, in which material all the detail is readily secured, and are then cast in plaster, a mold being secured by which they are readily multiplied to any extent. They are then put in the hands of the artists and carefully colored in solid oil paints to accurately resemble their appearance in nature, and in case of restorations or modern buildings, all the little additions are made which will give them the appearance of occupation. The Survey is in possession of the data for the construction of many more models, and they will be brought out as opportunity is given. They have also, in connection with the views, multiplied many of the curious pieces of pottery which have been brought back from that region by the various parties connected with the survey.

RECENT LITERATURE.

DARWIN'S DIFFERENT FORMS OF FLOWERS ON PLANTS OF THE SAME SPECIES[1].—All botanists may not become Darwins, but if a perusal of this and the other works of their talented author, should induce any of the present collectors of local floras, and describers of dried plants, to at least devote a moiety of their leisure to observing flowers, their daily conduct of life, how they grow and reproduce their kind, their relation to one another, to insects and to the world at large; observations, however, in many cases requiring care and patience, as well as some genius, then would in time be reared a crop of botanists, who would bridge the chasm now yawning between the ordinary herbalist—no farther advanced now, perhaps, than in the days of Gerarde—and the author of this book and its predecessors. This work, however, interesting as it is, was not written for the public, but for the few who have, since 1862, read the Journal of the Linnean Society, which contains the papers forming the body of this book, which are here republished in a connected and corrected form, together with some new matter, and is now in such an attractive form that few who have read Mr. Darwin's former writings will neglect the present work.

Premising that, in the words of the author, cleistogamic flowers are fertile, minute, completely closed, with the petals rudimentary, often with some of the anthers abortive, and the remaining ones together with the stigmas much reduced in size; that these flowers grow on the same plant with perfect and fully expanded flowers—we will now let the author give the results of his studies:

"I will now sum up very briefly the chief conclusions which seem to follow from the observations given in this volume. Cleistogamic flowers afford, as just stated, an abundant supply of seeds with little expenditure; and we can hardly doubt that they have had their structure modified and degraded for this special purpose; perfect flowers being still almost always produced so as to allow of occasional cross-fertilization. Hermaphrodite plants have often been rendered monœcious, diœcious, or polygamous; but as the separation of the sexes would have been injurious, had not pollen been already transported habitually by insects or by the wind from flower to flower, we may assume that the process of separation did not commence and was not completed for the sake of the advantages to be gained from cross-fertilization. The sole motive for the separation of the sexes which occurs to me, is that the production of a great number of seeds might become superfluous to a plant under changed conditions of life; and it might then be highly beneficial to it that the same flower or the same individual should not have its vital powers taxed, under the struggle for life

[1] *The Different Forms of Flowers on Plants of the same Species.* By CHARLES DARWIN, M. A., F. R. S., with illustrations. New York, D. Appleton & Co., 1877, 12mo., pp. 352.

to which all organisms are subjected, by producing both pollen and seeds. With respect to the plants belonging to the gyno-diœcious sub-class, or those which co-exist as hermaphrodites and females, it has been proved that they yield a much larger supply of seed than they would have done if they had all remained hermaphrodites; and we may feel sure from the large number of seeds produced by many plants that such production is often necessary or advantageous. It is therefore probable that the two forms in this sub-class have been separated or developed for this special end.

Various hermaphrodite plants have become heterostyled, and now exist under two or three forms; and we may confidently believe that this has been effected in order that cross-fertilization should be assured. For the full and legitimate fertilization of these plants pollen from the one form must be applied to the stigma of another. If the sexual elements belonging to the same form are united the union is an illegitimate one and more or less sterile. With dimorphic species two illegitimate unions, and with trimorphic species twelve are possible. There is reason to believe that the sterility of these unions has not been specially acquired, but follows as an incidental result from the sexual elements of the two or three forms having been adapted to act on one another in a particular manner, so that any other kind of union is inefficient, like that between distinct species. Another and still more remarkable incidental result is that the seedlings from an illegitimate union are often dwarfed and more or less or completely barren, like hybrids from the union of two widely distinct species."

BREHM'S ANIMAL LIFE.[1]—We have already (Vol. xi. p. 557) in general terms called attention to the elaborate and useful work of which the present volume forms a part. Prof. Taschenberg, the author of this volume, is well known for his studies on the lower Hymenoptera and his work on economic entomology. He brings to the task ripe scholarship, a pleasant style, and is aided by an artist whose success greatly enhances the value of the work. In a few introductory pages, Prof. Taschenberg treats of the anatomy, physiology, and transformations of insects, and then enters at once upon a very general description of the more interesting forms of the families of insects, beginning with the beetles and ending with the myriopods, spiders and mites. The *Linguatulidæ*, and *Pantopoda* (Pycnogonidæ) are included, and the Tardigrades are briefly noticed.

The work is well worth the cost to one even who cannot read German with facility, from the graphic, full-page illustrations, and the cuts which abound in the text. The picture of the dead and probably stinking mole hanging by its snare, and overrun with a

[1] *Brehm's Thierleben.* Band 9. Die Insekten, Tausenfüssler und Spinner. Von DR. E. L. TASCHENBERG. Mit 227 Abbildungen im Text und 21 Tafeln, von Emil Schmidt. Leipzig, 1877. New York, B. Westerman & Co. New York. 8vo. pp. 711, xx. $5.00.

host of scavenger beetles and flies, will give the beginner in entomology a graphic idea of the value of such a "find" to these insects; as will also the plate designed to face p. 62, of a dead bird with similar accompaniments. The plate entitled "a spring-

THE LOCUST OF THE OLD WORLD, NATURAL SIZE.

picture" and "insect-life" is well drawn, as is that of the ant's nest in the forest, and the "reign of flies," the "night-search for insects," and the bird-killing spider (*Mygale avicularia*). The cuts in the text are drawn by Herr Schmidt with fidelity and grace, very few stiff figures appearing.

We think more might have been said and pictured about the habits of bees and wasps, and some drawings of their nests, particularly those of the tropics, introduced. The accompanying cut of the locust of the Old World will give the reader some idea of the nature of the illustrations in the text, and give our western read-

ers a notion of the size and power of the creature by which in the eastern hemisphere the prophet Joel, who left us the first entomological monograph ever written, was so impressed.

NATURAL HISTORY AND GEOLOGY IN BOHEMIA.—We have received for notice several important works, containing many lithographic illustrations, upon the botany, natural history, palæontology and geology of Bohemia, by several scientists of Prague, entitled, Archiv für die Naturwissenschaftliche Landesdurchforschung von Böhmen, edited by Profs. Koristka and Krejei, who contribute several topographical and geological memoirs to the first volume, which appeared in 1869. Dr. Fric writes on the fossils of the chalk formation, and C. Feistmantel discusses the geology of the coal basin of Bohemia, while Dr. Celakovsky contributes a lengthy prodromus of the flora of Bohemia; Herr Lokaj catalogues the beetles; Alfred Slavik, the land and fresh-water molluscs, and E. Barta, the spiders. In the second volume, published in 1873, the prodromus of the flora is continued; and Dr. Fric enumerates the vertebrates and crustacea, and describes the river fisheries of Bohemia. The third part of the prodromus of the flora appeared in 1875, and in 1876 was published Rosicky's Myriopoda of Bohemia.

THE works of the Geological Division, as far as received by us, comprise Dr. Em. Boricky's petrographical studies on the basalts, phonolitic and melaphyr rocks of Bohemia, with six fine colored chromo-lithographic, and two plain plates (1874–1876). The second volume contains Dr. A. Fric's fauna of the coal formation of Bohemia, wherein he describes and figures a fossil scorpion (*Cyclopthalmus senior* Corda.), a new spider (*Palaranea borassifolia*), and a remarkable Tetradecapod crustacean (*Gampsonychus parallellus* Fric), with broad caudal appendages, and apparently forming a synthetic type, combining Decapod with Amphipod features, and bearing perhaps a family resemblance to our Illinois Carboniferous crustacean, *Acanthotelson* of Meek and Worthen; it has sessile eyes. Karl Feistmantel's Coal basins in different localities of Bohemia; Vala and Helmhacker's iron ores in the region of Prague and Beraun, and Helmhacker's geological description of portions of Bohemia, with a valuable work by Dr. G. C. Laube on the geology of the Erz mountains of Bohemia, are all valuable and fully illustrated; but undoubtedly Boricky's important work on microscopical petrography will excite a very considerable degree of interest among American geologists. The works can be obtained of Fr. Rivnac, the publisher, at Prague, Austria.

KIRBY'S SYNONYMIC CATALOGUE OF BUTTERFLIES.[1]—The appearance of the supplement to this work warrants some notice of one

[1] *A Synonymic Catalogue of Diurnal Lepidoptera.* By W. F. KIRBY. London, 1871. Supplement, March 1871—June, 1877. London, 1877, 8vo. pp. 883. Van Voorst.

of the most useful books of reference the entomologist can have upon his book-shelves. The original work forms a bulky octavo of 690 pages, while the supplement, even, is paged from 691 to 883. As this contains simply a synonymic list of one group of Lepidoptera, one may form some idea of its extent, and the labor involved in its preparation.

FERNS OF NORTH AMERICA.[1]—The first part, now before us, more than meets the expectations formed when the work was announced. Professor Eaton has treated the subject in a clear and methodical way; presenting in a popular form detailed descriptions characterized by the great merits of readability and accuracy. The plates are well done both by artist and lithographers. In the first part the following species are figured and described: *Lygodium palmatum*, *Cheilanthes vestita* and *cooperæ*, *Asplenium serratum*. There is also a synopsis of the species of Cheilanthes known to occur in the United States. This work of so much promise can be most heartily recommended to botanical teachers and students. The low price at which it is offered is a pleasant surprise to many who are familiar with the cost of such productions, and it is to be earnestly hoped that the projectors of this enterprise may receive from the public the support to which it is entitled.—*G. L. G.*

FLOWER'S OSTEOLOGY OF THE MAMMALIA.[2]—This valuable résumé of the osteology of the Mammalia, may be recommended to those desiring a knowledge of the subject, as the best manual in our language. While not exhaustive, it is full of information, especially in regard to cranial characters, and the text is elucidated by numerous and good wood-cuts. A number of allusions to the development of the several parts of the skeleton are scattered through the volume, and the systematic views of the writer are generally expressions of the latest results obtained in the field covered by the work. It furnishes an excellent introduction to the study of the palæontology of the *Mammalia*. Messrs. Macmillan have long since earned the thanks of biologists by their zeal in publishing works of this class, preferring in some instances at least the position of public instructors to the accumulation of large profits on outlays.

THE MORPHOLOGY OF THE SKULL,—by W. K. Parker and G. T. Bettany.[3] This is another of the excellent manuals published by the Messrs. Macmillan. It consists of a general abstract of the papers by Prof. W. K. Parker, chiefly published in The Philo-

[1] *Ferns of North America.* By Prof. DANIEL C. EATON, of Yale College. Published by S. E. Cassino, Naturalist's Agency, Salem, Mass. Part I, price $1.

[2] *An Introduction to the Osteology of the Mammalia.* By WM. HENRY FLOWER, F. R. S., F. R. C. S. London, Macmillan & Co., 12mo. pp. 349 Second Edition.

[3] *The Morphology of the Skull.* By Prof. W. K. PARKER, F. R. S., and F. BETTANY, M. A. London, Macmillan & Co., 1877. 12mo. pp. 368.

sophical Transactions of the Royal Society, on the development of the skull in various vertebrate animals. These are the skate and dogfish, the salmon, axolotl, frog, snake, fowl and pig. Appendices on the general structure of the skull of the orders to which these animals belong, together with one on the human skull, are added. A preliminary chapter on general embryology, and a closing one on the general homologies of the elements of the cartilaginous and osseous skulls, complete the work. The mode of treatment of the subject by Prof. Parker is lucid, and the text is illustrated by numerous excellent cuts. It is the best manual of the subject in the English language, and to the student of any aspect of the osteology of vertebrata, is invaluable. It introduces an extensive and difficult department to a large class who do not read German or French with sufficient facility to master the subject in those languages. We observe with pleasure that the authors are not contented with the dry enumeration of facts alone, but are willing to indulge in reflections on the wider bearings of their theme. Their observations on the homologies of the cranial elements, and the nature of the supposed segments, are interesting and judicious, and we refer to them (pp. 331, 342–3, 359) as models of cautious induction without affectation of an ignorance, which is greater than their knowledge of the facts demand.

RECENT BOOKS AND PAMPHLETS.—A Text Book of Physiology. By M. Foster, M.A., M.D., F.R.S. London: Macmillan & Co., 1877. 8vo, pp. 889. $6.00.

United States Geological Exploration of the Fortieth Parallel. Clarence King, Geologist-in-Charge. Microscopical Petrography. By Ferdinand Zirkel. Illustrated by twelve plates. Washington, 1876. 4to, pp. 297.

Sixth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois. The first biennial Report. By Cyrus Thomas, Ph.D. Springfield, Ill., 1877. 8vo, pp. 180.

Brehm's Thierleben. Band ii, Heft 8–11 iii. 1–8. Leipzig, 1877. New York: B. Westermann & Co. 8vo. 40 cents a Heft.

Zur Kenntniss des Einflusses der äusseren Lebensbedingungen auf die Organisation der Thiere. Von Wladimir Schmankewitsch (Zeitschrift für wiss. Zoologie. Band xxix). 8vo, pp. 65.

Life Histories of the Birds of Eastern Pennsylvania. By Thomas G. Gentry. Vol. ii. Salem, Mass., Naturalist's Agency. 1877. 12mo, pp. 336.

On New Forms of Actiniaria dredged in the Deep Sea; with a Description of certain Pelagic Surface-swimming Species. By H. N. Moseley. 4to, pp. 10, with a plate.

On two Forms of Deep-sea Ascidians; obtained during the voyage of H. M. S. *Challenger*. By H. N. Moseley. 4to, pp. 8. (From the Linnæan Transactions, Ser. 2d, vol. i.)

On the Structure of a species of Millepora occurring at Tahiti, Society Islands. By H. N. Moseley. (From the Philosophical Transactions of the Royal Society, vol. 167, part 1.) 4to, pp. 18.

On the larval Characters and Habits of the Blister-beetles, belonging to the genera Macrobasis Lec. and Epicauta Fabr.; with Remarks on other species of the family Meloidæ. On a remarkable new genus in Meloidæ infesting Mason-bee Cells in the United States. Additional Notes on Megathymus yuccæ. Further Remarks on Pronuba yuccasella, and on the Pollination of Yucca. On the Differences between Anisopteryx pometaria How., and Anisopteryx æscularia W.-V., with Remarks on the genus Paleacrita. By C. V. Riley. (From the Transactions of the Academy of Science of St. Louis. Vol. iii, No. 4.) 1877. 8vo, pp. 34.

Polar Colonization. The Preliminary Arctic Expedition of 1877. Washington, D. C. 8vo, pp. 32.

Immortality. All Life conditionally Immortal. By William Bross. Chicago: Jansen, McClurg & Co. 8vo, pp. 8.

The Geological Formations of La Salle county, and their Organic Remains. By William W. Calkins. 12mo, pp. 11.

Recent Investigations of Embryologists. By Charles Sedgwick Minot. (From the Proceedings of the Boston Society of Natural History, xix.) 8vo, pp. 7.

Report on the present state of our knowledge of the Crustacea. Part i, ii. On the Homologies of the Dermal Skeleton. By C. Spence Bate. (From the Report of the British Association for the Advancement of Science for 1875, 1876.) 8vo, pp. 12, 20.

Geology of Wisconsin, Surveys of 1873–1877; Vol, II. Part I, Historical; II, Eastern Wisconsin; III, Central Wisconsin; IV, Lead Region. Accompanied by an atlas of maps. Published under the direction of the Chief Geologist, T. C. Chamberlin, by the State Commissioners of Public Printing, Madison, Wis. 1877. 8vo, pp. 768.

Palæontological Bulletin, No. 28. On new Vertebrata from the Upper Tertiaries of the West. On new Saurians discovered by Mr. Wheatley in the Trias of Pennsylvania. On the Vertebrata of the Dakota Epoch of Colorado. By E. D. Cope. (Read before the American Philosophical Society, December 21, 1877.) 8vo, pp. 28.

Bulletin of the Buffalo Society of Natural Sciences; Vol III. Buffalo. From April, 1875, to August, 1877. 8vo, pp. 230.

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GENERAL NOTES.

BOTANY.

Lavalée's Arboretum Segrezianum.[1]—This is a handsome volume of some 500 pages, containing a catalogue of the trees and shrubs collected by Mons. Lavalée on his estate at Segrez, a few miles south of Paris, with their synonyms, origin, and with abundant references to the most accessible figures. In an interesting preface M. Lavalée tells us how, from a small beginning ten years ago, his collection has grown until it contains more than 3000 species and garden varieties; of the excessive labor which its formation and scientific arrangement has enjoined on him; and of the many difficulties he encountered in determining the names of the plants which he has ransacked Europe to procure. How admirably he has overcome these difficulties, difficulties which will hardly be appreciated except by those who have undertaken the formation of a large scientific collection of living plants, his pages tell.

The second portion of the preface is devoted to a by far too short historical sketch of the principal collections of exotic trees, which have been found in France from the time of René du Bellay, in the middle of the sixteenth century, down to that which Vilmorin brought together on his estate at Barres; now fortunately in possession of the State as a school of forestry.

[1] *Arboretum Segrezianum—Enumeration des Arbres et Arbrisseaux Cultivés à Segrez.* Par Alph. Lavalée. (Paris: J. B. Baillière et Fils. 1877.)

In the body of the catalogue a few errors are noticeable, mistakes in the spelling of foreign name are not infrequent, and the synonomy and origin of some plants (*Rubus didicerisus* is given as a native of Canada) will require correction for another edition, from which no doubt further study will remove some of the doubtful species credited to North America. To directors of botanic gardens, or to those whose duty it is to care for such collections, the *Arboretum Segrezianum* will be an invaluable aid. A volume of plates with technical descriptions of some of the last and little known species in M. Lavalée's Arboretum is promised, and is, we believe, already in press.—*C. S. Sargent.*

RESEARCHES IN REGARD TO TRANSPIRATION IN PLANTS.—J. Wiesner has published, in Annales des Sciences Naturelles, an account of his experiments upon this subject. The following is a statement of his conclusions:

The effect of light upon transpiration is most obvious in the case of plants of a green color. The comparison of green and etiolated maize does not leave any room for doubt.

The functions of chlorophyll in transpiration are evident. A part of the light which traverses the chlorophyll is transformed into heat, and from this results an elevation of temperature in the tissues. Increase of tension of aqueous vapor in the intercellular space follows, and the excess of vapor passes out by the stomata.

It is therefore easy to understand how a plant can transpire in a saturated atmosphere, but only under influence of light.

These experiments were conducted in three ways: by comparing green and etiolated plants, by exposing the plant to the solar spectrum, and by placing them behind solutions of chlorophyll.

The results from these three methods agree. They show that the presence of chlorophyll appreciably augments the action of light on transpiration; that it is the rays corresponding to the absorption bands of the chlorophyll spectrum, and not the more luminous rays which excite transpiration; and finally that the rays which have passed through a solution of chlorophyll exert only a feeble influence on transpiration.

Other coloring matters, like xanthophyll for example, act like chorophyll, but to a less degree. Wiesner does not deny that opening of the stomata may accelerate transpiration in sunlight, but the very great transpiration of maize, the stomata of which were closed, and the feeble transpiration of *Hartwegia comosa*, in which they were largely open in the dark, suffice to indicate that they are not the principal cause of transpiration in the light.

The dark heat rays act in a very appreciable manner, but less than the luminous rays. So far as the ultra-violet chemical rays are concerned their action is *nil* or exceedingly slight.

Whatever the nature of the rays, they always act by increasing the temperature of the tissues.

Wiesner concludes his paper by the statement: "The physiological end of the absorption of light is no longer a secret, and I have at the same time detected a new function of chlorophyll."—*Annales des Sciences Naturelles, September.*

To the above may be added a brief reference to a note by Déherain, in which he states that he had obtained results different from those of Wiesner, and that he is soon to criticise further Wiesner's paper.

Botanical News.—*Trimen's Journal of Botany* for December, besides articles of local interest, contains an interesting discussion of some questions of botanical nomenclature, by J. Ball; some contributions to plant-chemistry, by A. H. Church; notes on Japanese and Bermudian ferns, and notes on some hybrid brambles, by W. O. Focke; Julius Wiesner's work on the influence of light and radiant heat on the transpiration in plants is abstracted. The journal contains a discriminating review of Darwin's Different Forms of Flowers on Plants of the same Species.

The Bulletin of the Torrey Botanical Club for November and December, contains Wolle's enumeration of Fresh Water Algæ, which embraces upwards of 150 forms new to the United States, and 24 species new to science. Mr. Meehan describes the habits of *Gentiana andrewsii.* Mr. C. F. Austin describes *Danthonia faxoni* n. sp., and two new mosses, while Mr. Davenport presents a description of a new fern, *Cheilanthes viscida*, from California.

ZOÖLOGY.[1]

Peculiar Feathers of the young Ruddy Duck.—The unusually narrow, rigid and acuminate tail-feathers which constitute a character of the genus *Erismatura* are much more peculiar at an early stage of their growth. The curious structure will doubtless be new to most readers of the Naturalist.

The accompanying cut will give an idea of the general appearance of the feather, which is, in fact, double, one complete feather growing on the end of another, and the two being dissimilar in structure.

To the naked eye the terminal feather appears to be simply a prolongation of the shaft of the other, as a slightly swollen, stiff stem projecting an inch or more beyond the true web, and bearing upon its terminal half a bunch of loose, disconnected barbs, more or less recurved, and fringed with light fluffy barbules. With a lens this terminal portion is seen to be a distinct feather, complete in all its parts, borne upon the end of the other. It has a simple

[1] The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

cylindrical barrel for half its length; at the point where the vane begins, it sends off a bunch of barbs constituting an after-shaft; it then becomes channeled along the under side, and gives off its loose barbs alternately on either side, forming a disconnected vane; thus presenting all the more essential parts of a complete feather (whether barbicels and hooklets are present or not I cannot now determine for want of a microscope). The proximal half of this duplex affair is in all respects a perfect feather of ordinary character. The distinction of the two feathers is clearly seen at the point where the end of the channeled and densely-pithy shaft changes into the enlarged, cylindrical and nearly hollow quill of the terminal supplementary feather. The relations of the two being such, they must have sprouted from the same matrix, one after the other, the true feather following after the temporary downy one, which is deciduous, and falls off when the duckling is about ten inches long. The process is essentially the same, of course, as that by which the downy tip of an ordinary contour-feather is shed; but it might not be expected to occur in the case of such a particularly strong and stiff rectrix as Erismatura possesses.—*Elliott Coues, Turtle Mountain, Dakota, July,* 1874.

Note on Ranella clathrata Gray.—Last winter I collected the above species at Cedar Keys, Fla. I found the shells in shallow water, occupying *dead* shells of *Mercenaria mortoni*; also attached to the pretty little coral, *Oculina diffusa*. Through Mr. Bland I submitted specimens to Geo. W. Tryon, Jr., who, after a careful examination, identifies them as above. This is a west coast form not heretofore known to exist on the eastern coast, and adds another species to the list common to both oceans. *Ranella caudata* is our usual form, and abundant in Florida.—*W. W. Calkins.*

Sparrows and Peewees.—My residence is in the country (Chickies, Lancaster, Co., Pa.), and for about forty years the peewee flycatcher (*Sayornis fuscus*) has nested under my portico, until 1877, when several European or domestic sparrows (*Fringilla domestica*) appeared, and not only attacked the resisting peewees during several days when these were repairing their nest, but as fast as one party built the other demolished, tearing the nest to pieces and littering the porch below, without renewing or occupying the premises.—*S. S. Haldeman.*

The Prairie Chicken in California.—A fact of considerable interest to our sportsmen has recently been noted in connection with the prairie chicken. The absence of this choice bird of the prairies among the feathered game of California has been felt, and efforts have been made by individual enterprise to introduce and acclimate it. They have not been successful, and the possibility of this desirable result has remained in doubt. But it seems that the bird is solving the problem for us. Starting from the prairies

of Nebraska, it has followed the overland railroad westward, its appearance being noted from time to time in localities along the line where it had never before been seen. Gradually it followed westward until it reached Battle mountain and Winnemucca, on the line of the Central Pacific in Nevada. From these points it extended its wanderings northward into Surprise Valley, in north-eastern California, and is gradually spreading through the valleys extending down from Mount Shasta. Its diffusion over the whole State is now believed to be only a question of time and reasonable forbearance on the part of gunners.—*Salinas* (*California*) *Index.—Communicated by R. E. C. Stearns.*

On the Form of the Stapes in Dipodomys.—Upon making an examination of the bony ear of this animal recently, from specimens sent me through the courtesy of Professors Baird and Coues, from the National Museum, I was struck with the peculiarity in shape of the stapes, which did not present the usual flat base fitting into the fenestra ovalis. The part in question was very thin, inflated, hollow internally, with a salient rim jutting inwards, and a similar salient horizontal border or rim bounding it externally; from this flat rim the grooved crura arose, and united distally; an osseous tube giving passage to a vessel and nerve traverses the crural opening, as in many other Rodents and Insectivora. Looking at the base of the stapedial bone from the side above and little oblique it reminds one strongly of a minute hat with a rounded crown and narrow rim, while a view from the side calls to mind the shape of the carapace of an *Emys*. On making comparisons of my sketches with the remarkable collection of preparations of the internal ears of various vertebrates made by Professor Hyrtl, and now in the museum of the Philadelphia College of Physicians, to which I was very kindly permitted access through the courtesy of Dr. Bache, I found that the base of the stapes was similarly inflated with the convex surface dipping into the fenestrum, in *Hyrax*, *Mephitis*, *Erithizon*, and *Phalangista.—John A. Ryder.*

ANTHROPOLOGY.

Pliocene Man.—Prof. Cope has recently made an important addition to our knowledge of this subject in North America. He has received from Oregon a collection of fossils from an ancient lake-bed of Pliocene age which include the following species of mammalia: *Elephas primigenius*, *Equus occidentalis*; *E. major*; *Auchenia hesterna*; *A. major* Ow.; *A. vitakeriana* sp. nov.; *Mylodon* vel genus affine; *Lutra piscinaria*. Of birds: bones not distinguishable from those of *Podiceps occidentalis* and *Podibymbus podiceps*; others of *Graculus* similar in size to those of *Graculus penicillatus*. Fishes: *Catostomidæ* and *Cyprinidæ* of extinct species of *Alburnops* and *Anchybopsis*. Mingled in the same deposit in undistinguishable relation, were found

numerous flakes with arrow and spear heads of obsidian, many of them much tarnished by long erosion. All were lying mingled together on the surface of a bed of clay, which was covered by a deposit of "volcanic sand and ashes" of from fifteen to twenty feet in depth. This had been drifted away by the wind in some localities, thus exposing the remains. Great numbers of specimens of the fresh-water shell, *Carinifex newberryi*, of a white color, were found with the vertebrate fossils. The locality is the basin of a lake, a small remnant of which still remains, and is visited by numbers of *Mammalia* and water-birds at the present time.

POWELL'S NORTH AMERICAN ETHNOLOGY.—The first volume of a series of "Contributions to North American Ethnology" has recently been published at Washington, by Maj. J. W. Powell. It is a quarto volume of 361 pages, and contains a number of able papers, of which the following is a summary: Part I contains a paper "On the Distribution and Nomenclature of the Native Tribes of Alaska and adjacent territory," accompanied by an ethnographic map. The article consists of a brief review of the various tribes, their location and population; contributed by Mr. W. H. Dall. The same author is represented by a second paper, "On the succession of the Shell-heaps of the Aleutian Islands." This is a valuable contribution to our knowledge of the American *kjækkenmøddings*. The illustrations of the objects of art discovered among the different strata which mark the Littoral, the Fishing and the Hunting periods are numerous, and are described at length. Another article, by the same writer, "On the Origin of the Innuit" or Eskimo, concludes Part I. After reviewing the principal hypothesis of origin and migration, he assumes that the larger part of North America may have been peopled by way of Behring Straits. The appendix to Part I contains philological papers by Messrs. Furnhelm, Dall and Gibbs.

Part II consists of an interesting paper by Dr. Geo. Gibbs, concerning the habits and customs of the "Tribes of western Washington and north-western Oregon," with map showing the distribution of Indian tribes of Washington Territory, and a linguistic appendix, principally by Dr. Gibbs.—*E. A. Barber.*

ERRATUM.—Attention having been called, by Mr. E. Wilkinson, Jr., of Mansfield, Ohio, to a typographical error which occurred in one of my recent articles entitled "The Ancient and Modern Pueblo Tribes;" it may be well here to make the correction. On page 596 of Vol. XI of the NATURALIST, ancient *metates* or *tortilla* stones were described as measuring "a foot or fifteen *feet* square." It is scarcely necessary to state that *fifteen inches* was intended. Mr. W. further writes, "I have met with them (grinding stones) quite frequently, in fact every Mexican kitchen has one, and there seems to be an invariable size, viz: about 15 inches wide and 18 or 20 inches long."—*E. A. Barber.*

ANTHROPOLOGICAL NEWS.—Major Powell and Mr. F. W. Putnam, after the meeting of the American Association at Nashville, made some very important investigations among the mounds and slab-graves of Tennessee, of which Mr. Putnam will give an account in the next report of the Peabody Museum.

The Rev. Stephen Bowers has sent to the National Museum an exceedingly valuable collection of relics from the southern coast of California. The bone and shell implements and ornaments form the most attractive feature of the collection.

In the last volume of the Proceedings of the American Antiquarian Society, Mr. Stephen Salisbury, Jr., reproduces a romantic description of Dr. Le Plongeon's excavations in Yucatan, and his discovery of a statue called Chac-mool, with photo-lithographic drawings.

Some valuable information upon Mexican antiquities will be found in "Anales del Museo Nacional de Mexico, Tomo I., Entrega I^{a}, published in Mexico.

Mr. George J. Gibbs, of Turks and Caicos Islands, sends to the Smithsonian Institution a manuscript in which he endeavors to prove that those islands, and not Guanihani or Watlings Island, were the first landing place of Columbus. Enclosed in the manuscript was a photograph of another wooden stool, somewhat similar to that figured in the Smithsonian Report of 1876.

Jansen, McClurg & Co. have published in a separate pamphlet Gov. Bross's paper on immortality, or all life conditionally immortal, read before the American Association in Nashville.

The Munich Society of Anthropology have commenced the publication of a separate organ entitled "Beiträge zur Anthropologie und Urgeschichte Bayerns." The four parts already published are full of interesting matter and elegantly illustrated.

The following works of interest to anthropologists are announced: The Origin of Nations, Geo. Rawlinson (Scribner's); The Myths and Marvels of Astronomy, R. A. Proctor (Putnam); Mycenæ, Schlieman (Scribner's); Die Bevölkerung der Erde, Behm und Wagner (Supplement to Peterman's Mittheilungen); Works relating to the Eastern Question and to the Survey of India, Trübner's Catalogue; Cyprus, di Cesnola (Murray, London); The Cities and Cemeteries of Etruria, Geo. Dennis (ib.); China, a History of the Laws, Manners and Customs of the People, Ven. J. H. Gray (Macmillan).

In Professor Shield's recent work on the Final Philosophy are some very important sections upon anthropology.

On the shores of Mobile river, just above the city of Mobile, vast deposits of shells have been discovered. The Mobile and Ohio Railroad recently utilized one of these beds to pave their stock-yard, and in doing so unearthed some beautiful pottery and other relics of aboriginal settlement. Through the activity of Mr. K. M. Cunningham this treasure has been secured for the National Museum.

The following papers on American anthropology have appeared: Recent Discoveries in the American Bottom, by Mr. Henry R. Howland, Bull. Buffalo Soc. Nat. Sc., Mar. 2; The Mound-builders of Illinois, *Western Rev.*, Nov.; in the same periodical, the paper of H. A. Rush on Mound-builders in Missouri, before the American Association; Are the Indians dying out? S. N. Clarke, Bureau of Education; Col. Garrick Mallery read a paper before the Washington Philosophical Society, Dec. 8, upon the same subject; Rink's Greenland is reviewed in *Nature*, Nov. 22d; Die Indianer Canadas, *Globus*, xxxii; Aboriginal Pottery of Salt Springs, Ill., Geo. E. Sellers in *Popular Science Monthly*, Sept.; On the Antiquity of Man in America, Dr. Daniel Wilson in *Canadian Journal*, Oct.; two volumes of Maj. Powell's Contributions to American Ethnology will soon appear, Vol. II, by Gatschett, Mallery, and others, and Vol. III by Powers, Crook, Hazen, and Powell; Notes on the Zaparos, paper read before the London Anthropological Institute, Nov. 27th; Explorations of Don F. P. Moreno in Patagonia, *Geographical Magazine*, 1877, No. 8; Ueber die Eingeborenen von Chiloe, L. Martin in Zeitschrift für Ethnologie, 1877, H. 3; Das Land der Yukararer und dessen bewohner, H. v. Holten, same, Heft 2; Die gegenwärtige Läge der Indianer in den Vereinigten Staaten, Fred. v. Theilmann.—*O. T. Mason, Washington, D. C.*

GEOLOGY AND PALÆONTOLOGY.

A New Mastodon.—A new species of the *Tetralophodon* type has been recently discovered by Russell S. Hill, in the Loup Fork beds of Kansas, which is called by Prof. Cope (Palæontological Bulletin, No. 28) *T. campester*. It is allied to the *T. sivalensis* C. and F. in its dentition, and to the *T. longirostris* Kaup of Europe, in its lower jaw with prolonged symphysis. The specimen obtained has no indication of tusks in the symphysis, and the superior tusks have a broad band of enamel, which is not found in *T. longirostris* according to Vacek. *T. mirificus* Leidy, the only other American species of the group, has a short symphysis and a very different composition of the molar teeth. The *T. campester* is about the size of the African Elephant.

The Snout Fishes of the Kansas Chalk.—Prof. Cope recently read a paper before the meeting of the American Association for the Advancement of Science at Nashville, on the order of fishes named by him *Actinochiri* in the final report of the Hayden Survey, stating that the genus *Erisichthe* must be referred to it. Species in England had been referred by Dixon to the genus *Saurocephalus*, and Sir P. D. G. Egerton had discovered that they possessed a snout somewhat like that of the sword fish. Prof. Mudge ascertained the same fact regarding

the American species, and Prof. Cope discovered that the fin structure was that of the order above named. These fishes were, then, fully armed; first, with an acute bony rostral weapon; second, with large lancet-like teeth; and third, with acute-edged bony pectoral spines.

A NEW GENUS OF OREODONTIDÆ.—From the Upper Miocene (Pliocene) of Montana, has recently been described by Prof. Cope, a new genus of *Oreodontidæ*, which holds an interesting intermediate position. It has the full dental formula and preorbital fossa of *Oreodon*, but the premaxillary bones form a single mass, as in *Merycochœrus*, and there is a large lachrymal vacuity as in *Leptauchenia*. It differs from the last genus in the absence of frontal vacuities. The molars are short-crowned, and not prismatic. It is named *Ticholeptus*, and the typical species, *T. zygomaticus*, is the size of *Oreodon major*. It has widely expanded zygomata, which have a horizontal plate-like extension at the glenoid region. The anterior face of the united premaxillaries is flat, and the nareal fissure is deep. The molar teeth are remarkable for their wing-like external ribs, which curve forwards. Length of molar series M. .097; width of premaxillary in front .032; length of cranium .225.

PALÆONTOLOGY OF GEORGIA.—Prof. Little, director of the Geological Survey of Georgia, has accumulated a valuable collection of the vertebrate fossils of that State, of cretaceous and tertiary age. Among these there have been identified the dinosaurian *Hadrosaurus tripos*, and the turtles *Taphrosphys strenuus* and *Amphiemys oxysternum*, a new genus and species related to *Adocus*. Mr. Loughridge of the survey also discovered a very fine specimen of that rare Propleurid, the *Peritresius ornatus*.

SILURIAN AND CARBONIFEROUS PLANTS.—Prof. Lesquereux read before the American Philosophical Society of Philadelphia, last October, two papers, one describing a fungus (*Rhizomorpha sigillariæ*), discovered under the bark of a *Sigillaria* from the Cannelton coal of Beaver Co., Penn. The other describes four species of plants from the Lower Silurian, viz.: a *Psilophyton* and *Sphenophyllum* from the Cincinnati group of Covington, and a *Psilophyton* and an *Annularia* from the Lower Helderberg of Michigan. The first remains of land plants from the Lower Silurian were discovered by Dr. Scoville in the Cincinnati beds near Lebanon, Ohio.

A NEW ALLY OF SIVATHERIUM.—Dr. R. Lydekker of the geological survey of India, has recently discovered a new genus allied to *Sivatherium* which is of much interest. It lacks anterior horn-cores, and has but a single base for horns on the vertex.

EXTINCT REPTILES OF INDIA.—Dr. Lydekker describes the first *Plesiosaurus* discovered in India from the Umia beds of Kach. He refers to the discovery of remains of *Megalosaurus* from the upper cretaceous of Trichinopoli, and mentions the existence of a huge dinosaurian in the Lameta rocks of Jabalpur. It is represented by a femur and caudal vertebræ, and he names it *Titanosaurius indicus*. He, however, does not define the genus to which he desires the name to apply.

PALÆONTOLOGICAL COURSE.—This course, at the Jardin des Plantes, by Prof. Albert Gaudry, includes an interesting discussion of the evidences of descent to be observed in the teeth and feet of the *Mammalia artiodactyla*. One part of it published in the Revue Scientifique is illustrated with many excellent cuts which convey important evidence to the eye. He refers to American observations in the same field, but commits a minor error in ascribing three upper incisors to the genus *Procamelus*, stating that Leidy has so determined it. The fact is that Dr. Leidy was unacquainted with the superior incisors of that genus, and that Prof. Cope first showed that it possesses but one, as in *Camelus*. Prof. Cope, however, discovered the genus *Protolabis*, which possesses the three superior incisors referred to by Prof. Gaudry.

GEOLOGY OF WISCONSIN.[1]—The Geological Survey of Wisconsin first instituted by the late Dr. I. A. Lapham, has been carried on with evident vigor by Prof. T. C. Chamberlain, and his assistants, R. D. Irving and Moses Strong. While Professor Chamberlain reports on the geology of Eastern Wisconsin, Mr. Irving describes that of Central Wisconsin, and Mr. Strong discusses the geology and topography of the lead region. An appendix on microscopic lithology is contributed by Charles E. Wright. The illustrations are numerous and excellent, and the atlas of thirteen maps further enhances the value of the report. We have been especially interested in the account of the surface geology of the eastern portion of the state, particularly the description of the ancient fiords which run into Lake Michigan, and the determination of the Kettle range to be an old terminal moraine, as abundantly proved by the interesting and excellent diagram facing p. 204.

GEOGRAPHY AND TRAVELS.

GEOGRAPHICAL WORK OF HAYDEN'S SURVEY.—A photolithographic plate of the primary triangulation carried on during the summer of 1877. by Mr. A. D. Wilson, Chief Topographer, has just been published by the U. S. Geological Survey, under the charge of Dr. F. V. Hayden. The area covered by these triangles extends from Fort Steele in Wyoming territory, westward to Ogden in Utah territory, a distance of about 260 miles, and north

[1] *Geology of Wisconsin.* Survey of 1873–1877, Vol. II., accompanied by an Atlas of Maps. Madison, 1877. 8° pp. 768.

as far as the Grand Teton, near the Yellowstone National Park, including Frémont's peak of the Wind River range of the Rocky mountains. The area embraces about twenty-eight thousand square miles, and within it, twenty-six primary stations were occupied and their positions accurately computed.

Besides these occupied stations a large number of mountain peaks were located, which in the future will be occupied as points for the extension of the topographical work of the survey.

A base line was carefully measured near Rawlins' springs, on the line of the Union Pacific railroad, and from this initial base the work was extended north and west to the valley of Bear river in Idaho territory. Here a check base was measured and the sytem expanded to the neighboring mountain peaks to connect with the triangulation as brought forward from the first mentioned base.

Along the line of the Union Pacific railroad the work was connected at six points with the triangulation system of Clarence King's 40th parallel survey.

In addition to the importance of this sheet as the base work of the season's topographical work it presents a most striking feature in the number of remarkably long sights which were taken from the summits of some of the most lofty mountains in the area explored. Many of these sights were over one hundred miles in length, while some reach a distance of one hundred and thirty-five miles. From Wind river peak all the prominent points in the Big Horn mountains were sighted, also the loftier peaks of the Uinta mountains; the former are located one hundred and sixty-five miles to the north-east, while the Uinta mountains are situated about the same distance to the south-west. As these ranges were not in the scope of the season's work they are not given on the chart.

The American Geographical Society.—In referring, however briefly, to the geographical work of our Transatlantic brethren, it must be considered a fitting opportunity to offer our congratulations to the American Geographical Society, which, incorporated in 1852, has now fully attained its majority; and the occasion is the more appropriate, as the society has recently acquired a new and commodious home, for which it is indebted to the public spirit and liberality so characteristic of American citizens, under the able direction of its distinguished President, Chief Justice Daly, whose eloquence and heartfelt regard for our favorite science cannot fail to have impressed his hearers during his late visit to this country. The American Geographical Society now numbers 1750 fellows, and possesses a geographical library of some 10,000 volumes and a large collection of maps, &c. Geographical operations on a large scale have been engrossed by the state in America; but the numerous and valuable papers contain-

ed in the twelve volumes of "Proceedings," "Bulletin," and "Journal," issued by the society since 1852, sufficiently attest the vitality of geography in the country at large.—*Sir Rutherford Alcock's address before the London Geographical Society.*

GEOGRAPHICAL NEWS.—Mr. Wetherman has published at Lima a valuable report on his exploration of the Peruvian tributaries of the Amazon, giving an account of an adventurous descent of the rivers Perene, Tambo, and Ucayali, in balsas, specially constructed for the purpose, says the *Geographical Magazine*.—A Dutch Arctic reconnoissance has been resolved upon by the Dutch Arctic Committee, which will dispatch in the next May a small sailing vessel of 85 tons to the Spitzberger and Barents seas. The expedition is paid for by the voluntary contributions of the whole people of Holland.—Herr Kiepert has lately presented to the Berlin Geographical Society a new map of Armenia, which embraces all available information and shows many additions to our previous knowledge of that region.—Among new books are, Upper Egypt, its People and its Products, by C. B. Klunzinger, M.D., with a prefatory notice, by Dr. George Schweinfurth (London, Blackie. 1878); The Monuments of Upper Egypt; A Translation of the Itinéraire de la Haute Egypte, of Auguste Marietto Bey (London: Trübner, 1877).

MICROSCOPY.[1]

THE POSTAL CLUB.—During the past year this society has continued its operations with full numbers, and with marked interest on the part of its members. The varied character of the objects contributed, and the sociable, gossipy nature of the notes, have made the boxes welcome throughout every part of the twenty-seven circuits. Comparatively few slides have been broken on the way or by careless handling, especially in those circuits where the new style of boxes has been in use; and scarcely any annoyance has been experienced except an occasional refusal of some postmaster to take the boxes because they contained glass. Even the difficulty in regard to the legality of mailing the slides has been as yet but a small and exceptional evil. The law against mailing glass is plain enough, the slides are unquestionably glass, and the objects are doubtless articles contained in glass; and it has been known from the first that to demand our rights under the law would be to break up the very useful practice of sending slides through the mails. Where the slides are properly packed and posted, however, without question or comment, there are very few postmasters known to be so stupidly officious as to take any notice of an act so perfectly harmless in itself and so entirely in accordance with the spirit of the law.

In addition to the regular boxes of the club, several contribu-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

tions have been made during the year of special boxes of such excellence as to require particular mention. One of these is a set of exquisite vegetable sections, double-stained in compound dye by Dr. Beatty's method, prepared and contributed by W. G. Corthel of Boston. Another, a series of unsurpassed crystallizations for the polariscope, by G. E. Bailey, of Lincoln, Neb. And a third, the beautiful preparations of Bermuda shells, by C. C. Merriam, of Rochester, already described in the NATURALIST.

During the year the club has lost two well-known members by death, Edwin Bicknell, of Cambridge, one of the most skillful of workers both with the instrument and at the preparing table, and Dr. Geo. D. Beatty, of Baltimore, one of the most talented, cultivated and promising of the cultivators of microscopy in this country.

The offices of secretary and treasurer have heretofore been combined, and ably filled by the Rev. A. B. Hervey, of Troy, to whose thorough and genial management the club is indebted for much of its success. The duties of the position having outgrown the time at his command and compelled him to offer his resignation, the managers have determined to recommend, instead of accepting the resignation, to divide the office and the labor by electing a separate treasurer who shall also act as assistant secretary. This change will doubtless be adopted by the club, and add to the ease and efficiency of its management.

A NEW MAILING BOX FOR SLIDES.—A new style of mailing box contrived by Dr. R. H. Ward, has been adopted by the Postal Club, and has proved successful beyond anything tried before. An account of it is therefore published in the hope that it may be made more generally useful.

In the boxes hitherto used for posting slides, the slides are occasionally found shattered to pieces, while the box containing them is quite uninjured or only a little strained. In some boxes containing six or twelve slides, half or more of the slides have been found broken in a perfectly sound box. This seemed to indicate not the effect of a crushing blow but the result of the inertia of the slide itself, which was only supported by the wooden racks at the ends and more or less perfectly by the cotton stuffed around it. An adequate occasion for such an accident might be furnished by throwing the mail-bag from a wagon to the pavement, or transferring it to or from a rapidly-moving train. It was therefore decided to reject the wooden rack altogether, and instead to support the slide by the whole of its edges and much of its sides by cloth, leather, india-rubber, or other soft and evenly-yielding material. This may be attained with the common boxes by removing the racks, lining the top, bottom and ends with thick, soft cloth, and arranging folds of the cloth, glued or stitched in place, like a rack at each end of the box so that a double thick-

ness of the cloth shall extend between the slides from each end one inch towards the centre. It is better, however, to have the boxes made for this use somewhat larger than the customary size, so that very thick beaver cloth can be used for the packing. For six slides a box may be made of hard wood 3-16ths of an inch thick, 3⅜ inches long, 1¼ wide and 1¼ deep inside measurement. The folds of cloth should be so arranged that not more than an inch in the centre of the slide is unsupported, except when large cover-glasses are to be used, when more space should be left to avoid pressing on the cover. The outside of the box is covered with strong thin cloth.

The comparative safety of this method is indicated by the experience of the Postal Club. During a trial of several months in many of the circuits, not one slide is known to have been broken while packed in this manner, while to slides in the ordinary boxes with wooden racks accidents are unfortunately frequent. For sending by express these boxes should be made of thicker wood, or enclosed in larger cases, to prevent crushing by the weight of heavy packages among which they may be carried.

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SCIENTIFIC NEWS.

— At the late meeting of the American Association for the Advancement of Science at Nashville, Tenn., Dr. T. Sterry Hunt presented a report on the subject of an International Geological Congress, from which we extract the following:

"The Committee to arrange for an International Geological Exhibition and Congress, to be held in Paris in 1878, was appointed by this Association at Buffalo, in August, 1876, and consisted of Messrs. W. B. Rogers, James Hall, J. W. Dawson, J. S. Newberry, T. Sterry Hunt, R. Pumpelly, and C. H. Hitchcock, together with T. H. Huxley for England, O. Torell, for Sweden, and E. H. von Baumhauer for Holland. At a meeting of the committee at Buffalo on the 25th of August, 1876, James Hall was chosen chairman, and T. Sterry Hunt, secretary. It was then agreed to prepare a circular, setting forth the plan of an International Geological Exhibition, which should form a part of the general Exhibition to be held at Paris in 1878, and indicating a scheme for the organization of the geological collections to be sent thereto by the nations taking a part in that exhibition, and, moreover, proposing an International Geological Congress to be held at Paris."

"The circular in accordance with this plan was duly prepared and printed in English, French and German, and before the end of the year had been sent by the Secretary to the principal scientific societies and academies, as well as to the workers in

Geology throughout the world. The response to this invitation has been most gratifying. The Geological Society of France has formally recognized the great importance of the objects proposed, and promised its hearty co-operation, while private letters from its President to the Secretary of the Committee, and from Prof. Hébert to Prof. Hall, give cordial assurances of the same kind. Spanish and Italian geologists have translated and published the circular in their respective languages, and have communicated to the Secretary their hearty approval of the plan. Prof. Capellini has, in this connection, published an interesting correspondence, calling attention to the fact that, in 1874, he had laid the project of a similar International Geological Congress, to be held in Italy, before the Italian Minister of Agriculture, Industry and Commerce."

"The Geological Society of London and the Geological Survey of Great Britain have also formally signified their approval of our objects, and the co-operation of Norway, Sweden, Russia and Austria-Hungary is promised. It is to be regretted that Germany has declined to take a part in the International Exhibition of 1878, but we trust that this will not prevent her geologists from joining in the proposed Congress. The Director of the Geological Survey of Japan promises to aid in our work, and we have the same assurance from Brazil, where the circular has been translated into Portuguese. Chili and Mexico have also responded, and promise an ample representation of their geology at Paris next year, while Canada, both through her Geological Survey and in the person of Dr. Dawson, will probably be represented there."

"The Government of the United States has as yet failed to accept the invitation of France to take a part in the Exhibition of 1878, so that American geologists are not certain that they will be able to participate in the International Geological Exhibition. We are, however, assured, that the Government is very desirous to have our country duly represented at Paris; and it is to be hoped that at the approaching extra session of the United States Congress measures will be taken for accepting the French invitation, and appointing a commission, so that our people may secure a representation in Paris. I am assured, on all sides, that our geologists desire to contribute largely to the International Exhibition, and even at this late day it will be possible to do much. In any event it is probable that several members of our committee will be present at the proposed Geological Congress. The precise date of this has not yet been fixed, though your Secretary is now in correspondence with the Secretary of the Geological Society of France upon this point, and believes that with the co-operation of that body, a time convenient to all will be agreed upon."

"It is recommended by the Standing Committee of the Asso-

ciation that, in addition to the names of J. P. Lesley, of Philadelphia, and Prof. A. C. Ramsay, director of the Geological Survey of Great Britain, already added to the International Committee, the Presidents, for the time being, of the Geological Societies of France, London, Edinburgh, and Dublin, of Berlin, of Belgium, Italy, Spain, Portugal, and the Imperial Geological Institute of Vienna, be invited to form part of our Commission."—*T. Sterry Hunt, Secretary of the International Committee.*

Shortly after the presentation of the above report the Secretary received official notice that the Geological Society of France had, in co-operation with the above plan, appointed at Paris a local committee of organization for the proposed Congress, constituted as follows: Hébert, president; Tournouer and Albert Gaudry, vice-presidents; Bioche, treasurer; Jaunetaz, secretary-general; Delaire, Sauvage, Brocchi and Vélain, secretaries; with the following, Belgrand, Bureau, de Chancourtois, G. Cotteau, Damour, Daubrée, Delafosse, Delesse, Descloizeaux, Desnoyers, Fougué, V. Gervais, Gruner, De Lapparent, Mallard, Milne-Edwards, Pellat, Marquis de Roys and L. Vaillant, members of the committee.

A circular issued by this committee, bearing date July 31, invites all those interested in geological, mineralogical and palæontological studies to take part in the approaching congress, and to subscribe the sum of *twelve francs* each, which will give a card of admission to the congress, and right to all the publications thereof. All those who intend to be present are at the same time invited to send, as soon as possible, a list of the questions which seem to them worthy of general discussion, as well as of the communications which they propose to make touching these questions. They are also invited to indicate which time appears to them most convenient for the meeting of the congress.

As regards an International Geological Exhibition, the Paris Committee of Organization state that the difficulty of finding a suitable locality seems to them an obstacle in the way of realizing this part of the programme. They hope, however, that there will be many special collections sent, and beg the exhibitors of such to give the committee due notice of these, in order that a special catalogue of them may be prepared.

The Secretary of the International Committee desires, in this connection, to call attention to the fact that his circular did not contemplate the holding of an International Geological Exhibition apart from the Universal Exhibition, but, in the language of that circular, *the making as complete as possible the Geological Department of the Universal Exhibition.*

It is certain that, as at all previous similar exhibitions, the different nations will contribute more or less of geological material, and it was conceived that such collections, extended and systematized in accordance with the plan set forth in the cir-

cular, would, while forming a part of the Universal Exhibition, without farther cost, meet all the requirements of an International Geological Exhibition. To the accomplishment of this end it will only be necessary for the exhibitors of all nations to send a list of their geological contributors to the local committee of organization at Paris.

All correspondence relating to the congress should be addressed to Dr. Jaunetaz, secrétaire-général, rue des grands Augustins 7, Paris, France, and all moneys sent to Dr. Bioche, at the same address.

— Russell S. Hill has recently returned to Philadelphia from Kansas, where he as been, for several months past, exploring for Prof. E. D. Cope. He discovered many fine vertebrate fossils, including a *Protostega gigas*, the bones of which, cleaned from the matrix, weighs three hundred pounds. He also discovered the new mastodont *Tetralophodon campester*, and numerous other mammalia.

ERRATA.—Page 51, second paragraph of Botany, first line, for "ized" read "ined;" second, for "Applopappus" read "Aplopappus;" fourth, for "mensiesii" read "menziesii" twice; seventh, for "empitriformis" read "empetriformis;" eighth, for "Erigonium" read "Eriogonum" twice; tenth, for "Polymonium" read "Polemonium;" next paragraph, for "Booth" read "Boott; also in first paragraph.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON, D. C., NOV. 24, 1877.

—His annual address was read by the President, Prof. Joseph Henry. It included a sketch of the methods of scientific research, and an account of the progress of investigations into the phenomena of sound as exemplified by fog-signals. It was shown that experiments of all kinds tended to increase the probability that refraction of the sound waves or beams was the chief factor in producing the supposed abnormalities.

Lieutenent-Colonel Garrick Mallery, U. S. A., read a paper on certain errors, in general acceptance, in regard to our aborigines. It was especially devoted to showing that the number of Indians in the United States, exclusive of Alaska, in spite of losses by violent death, is probably on the increase, and that the discrepancy between their present numbers and the earlier accounts is chiefly due to the exaggerated and erroneous nature of the latter. This paper being unfinished when the hour of adjournment arrived, the remainder was postponed until the next meeting.

Dec. 8, 1877.—The same paper was continued. The author referred to poisoning arrow-points, belief in a single supreme spirit or deity, supposed knowledge of medicine or medicinal properties of plants, etc., as being in the category of popular

errors, time-honored but with slender foundation. The paper was the occasion of much discussion, and occupied the entire evening.

American Geographical Society.—Dec. 17, 1877, Mr. J. A. Bennett, Esq., read a paper entitled My first Trip up the Magdalena, and Life in the "Heart of the Andes."—Jan. 8, 1878, Rev. W. E. Griffis read a paper on Japan, Geographical and Social, with personal experiences.

Boston Society of Natural History.—Dec. 19, 1877, Prof. E. S. Morse made some observations on the habits and structure of Lingula, including his discovery of otoliths, which had not been previously known to exist in any Brachiopods.—Jan. 2, 1878, Dr. T. Sterry Hunt made a communication on some geological features of North Carolina, and Mr. J. A. Allen remarked on an "Inadequate Theory of Birds' Nests."

Appalachaian Mountain Club.—Dec. 12, Prof. G. Lanza described an ascent of Scar Ridge, a mountain lying north-west of Mt. Osceola, and Mr. Warren Upham spoke concerning some unnamed mountains between Mt. Hancock and Scar Ridge.

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SCIENTIFIC SERIALS.[1]

The Geographical Magazine.—December. Indian Famines and Sun Spots. Water-partings *versus* Ranges, by R. B. Shaw. The Arctic Föhn, by Sir G. S. Nares. Mr. Stanley's Voyage down the Congo (with Stanley's map of the Congo river).

The Geological Magazine.—December. American "Surface Geology," and its relations to British, by S. V. Wood.

Annals and Magazine of Natural History.—December. Report on the Echinodermata collected during the Arctic Expedition, 1875-76, by P. M. Duncan and W. P. Sladen. The Post-tertiary Beds of Grinnell Land and North Greenland, by H. W. Feilden. The Nomenclature of the Groups of Ratitæ, by Alfred Newton.

[1] The articles enumerated under this head are, for the most part, selected.

THE

AMERICAN NATURALIST.

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ON THE TRANSFORMATIONS OF THE RED MITES.[1]

BY PROF. C. V. RILEY.

The Locust Mite (*Trombidium locustarum* Riley).—One of the most interesting as well as one of the most important of our locust enemies is what we may popularly call the Locust Mite. It forms a true link between those articulates which prey on the eggs and those which prey on the locusts, since it combines both traits. Referred to in previous writings under the name of the silky mite, its natural history was first fully made out by the writer during the past summer. It differs so much in infancy and maturity that it has been referred to distinct genera, and was always known under two different names. During either period it proves a bitter enemy to the locust. In the mature form it lives in the ground, feeding upon all sorts of soft animal and decomposing vegetable matter. When the locust fills the ground with its eggs this mite flourishes upon the abundance of food which these afford, sometimes teeming to such an extent as to give the ground a scarlet hue. How numerous and how beneficial to man as a locust-egg destroyer this mite may be, is well illustrated by the statements in the Appendix.[2] In spring the female lays between 300 and 400 minute spherical, orange-red eggs in the ground. (Fig. 1*a*.) From these eggs in due time there hatch little orange mites (Fig. 1*b*), which differ from the parent in having but six legs. This six-legged form belongs to Latreille's genus *Astoma*, erected when naturalists had no suspicion that it was purely a larval form. The specific name

[1] Extracted from advance copy for the First Annual Report of the U. S. Entomological Commission.

[2] These details are here omitted.

locustarum was first proposed for it by B. D. Walsh,[1] but Dr. Le Baron afterwards gave it the name of *Atoma gryllaria*,[2] in connection with a detailed description.

Active when they first hatch and impelled by instinct, these

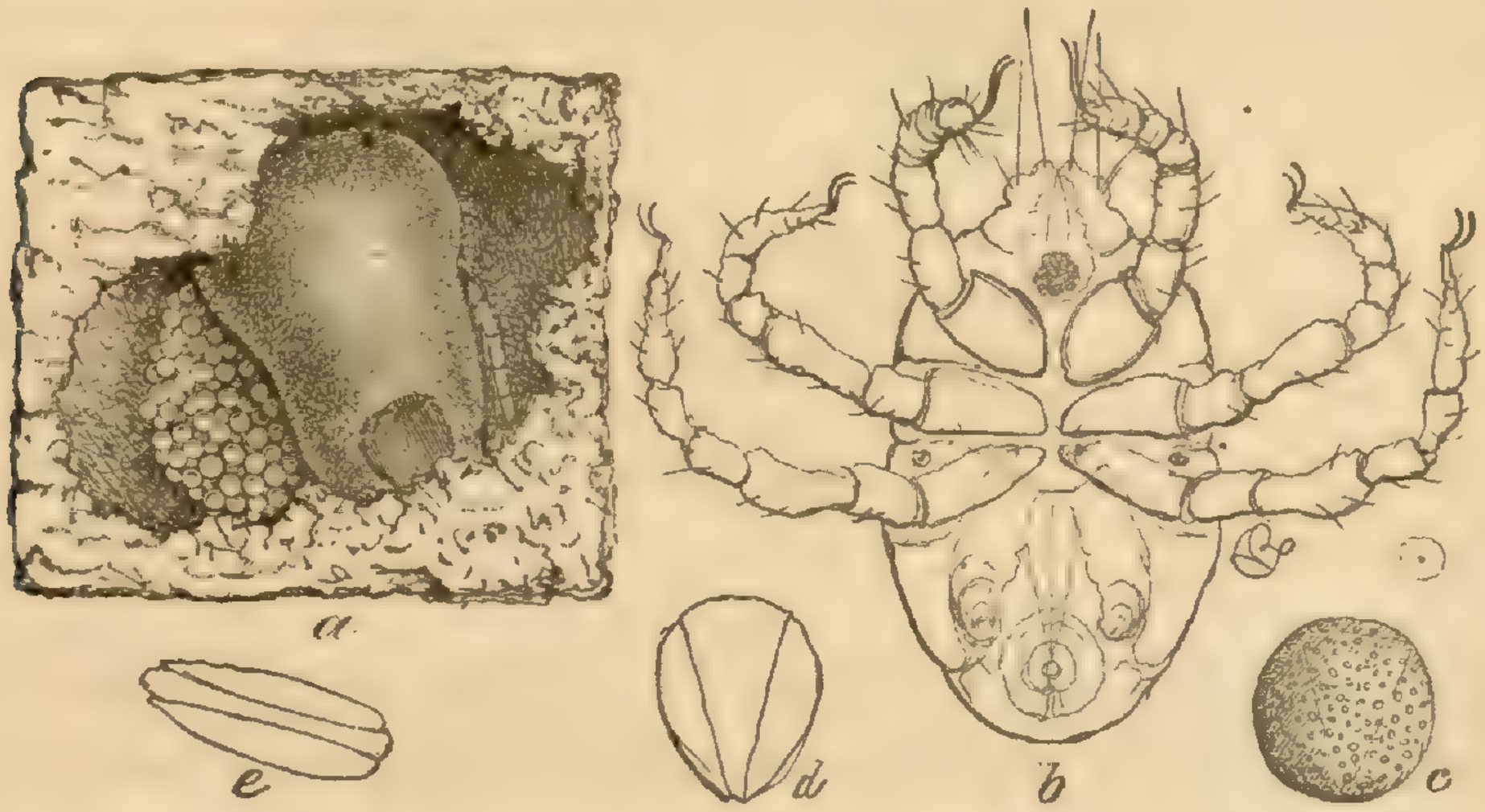

Fig. 1.—*Trombidium locustarum*:—*a*, female with her batch of eggs (after Emerton); *b*, newly hatched larva—natural size indicated by the dot within the circle; *c*, egg; *d*, *e*, vacated egg-shells (after Riley).

little six-legged specks crawl upon the locusts and fasten to them, mostly at the base of the wings or along their principal veins, just as a tick fastens to a dog, or a sheep, or to man. Thus attached to their victim they suck its juices and swell until the legs become invisible. It is in this condition (Fig. 2*a*) that they

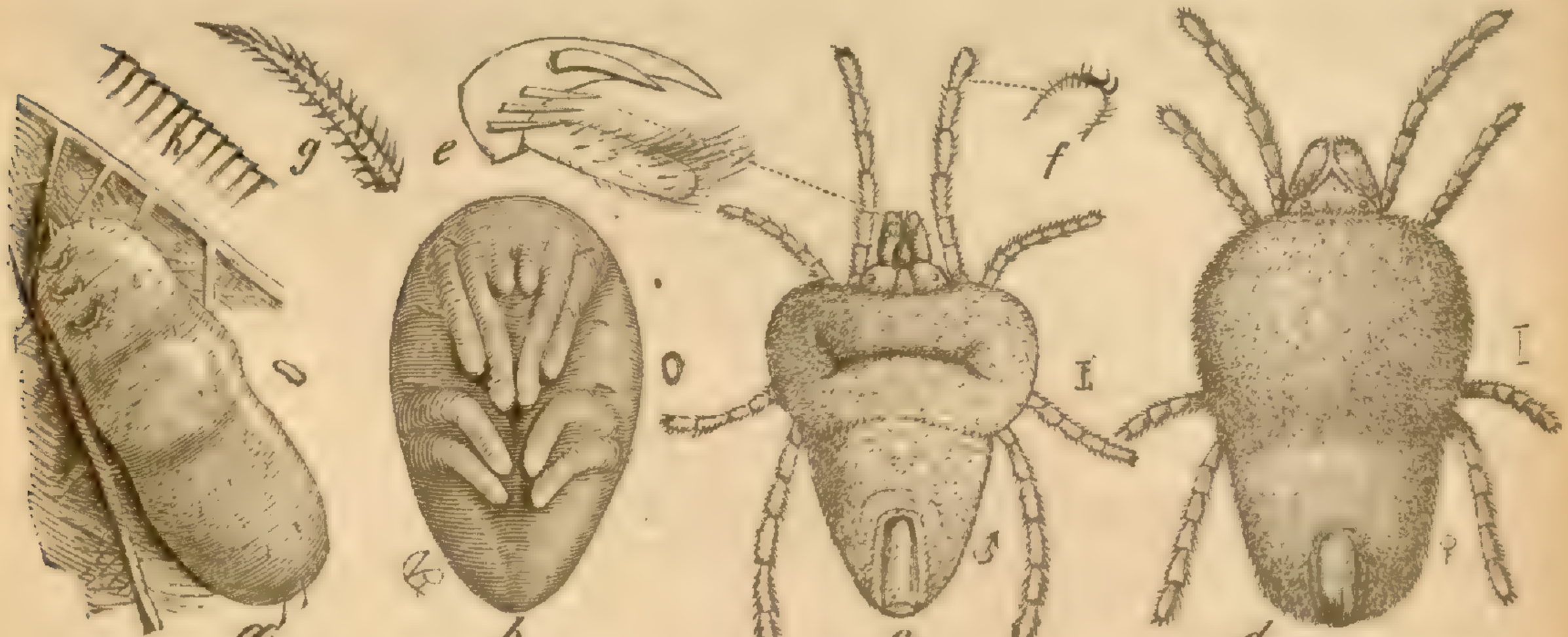

Fig. 2.—*Trombidium locustarum*:—*a*, mature larva when about to leave the wing of a locust; *b*, pupa; *c*, male adult when just from the pupa; *d*, female—the natural sizes indicated to the right; *e*, palpal claw and thumb; *f*, pedal claws; *g*, one of the barbed hairs; *h*, the striations on the larval skin. (*d*, after Emerton.)

[1] Practical Entomologist, 1, p. 126.

[2] Le Baron's Second Illinois Ent. Report., 1872, p. 156. The author employs the term *Atoma*, which, though at first employed by Latreille, is corrected to *Astoma* in his Genera Crustaceorum et Insectorum, 1, p. 162 (1806).

are most often noticed, presenting to the ordinary observer the appearance of a bright red oblong-ovoid body growing from the wing. They are so firmly attached by the mouth, so immovable, and with the legs so short and hidden, that persons unfamiliar with their true nature might easily mistake them for some natural growth or excrescence. That they are often so numerous as to weaken and kill their victim, reports clearly prove.

In due time these swollen bodies let go their hold and drop to the ground where, clumsily and with difficulty, they crawl under the first shelter afforded by some bit of loose earth, or a stone. Here they remain quiet for two or three weeks, gradually swelling and changing form. During this change the pupa state is assumed, but not by shedding any skin as do true insects in going through their transformations. New legs, feelers and mouth-parts form under the old skin, which, with its now useless legs, distends so as barely to cover the new parts, which are all appressed to the body very much as in the pupa of a beetle. (Fig. 2*b*.) Finally both the distended larval skin and the new one that incases the pupa burst, and release a creature quite different from the former Astoma—in fact, none other than the 8-legged Trombidium. (Fig. 2*c*.) We thus see that from the time this mite hatches, through all its growth and changes, but one molt takes place. The mature form passes the winter in the ground, and is active whenever the temperature is a few degrees above freezing point.

Only two species of the genus Trombidium have been described in America, viz: *scabrum* Say, and *sericeum* Say.[1] The descriptions in both cases are brief, and lacking in structural details and in measurements. The locust mite under consideration has been hitherto referred to *sericeum*, but the characteristic polished anal plate precludes the reference, and we define it under the name of *locustarum*. Since the time when it was established by Fabricius, evidently on the characters of the European *T. holosericum*, the genus *Trombidium* has been greatly modified by different authors. The species have been variously arranged according to relative length of legs, position of eyes, divisions of the body, etc. As restricted at present, the genus is thus characterized. Abdomen swollen, especially in front where it is broadest; cephalo-thorax small and narrow, with two eyes, superior and barely raised;

[1] Journ. Ac. Nat. Sc. Phil. 11, 1821, p. 70.

legs 7-jointed, palpate, with two minute terminal hooks, the front pair longest the two front pair widely separated from the two hind pair; mandibles unguiculate; palpi large, free, the penultimate joint strongly ungulate, and the terminal joint forming a movable thumb upon it. Larva 6-legged, parasitic; defined under the generic names *Astoma*, *Leptus*, *Lepostomus* and *Ocypete*. Many species have been described in Europe, but the one in question differs from all of them as given by Gervais.[1]

Trombidium locustarum Riley.—Egg, 0.12 mm. in diameter, spherical, full of granulations, pale orange-red in color, becoming more pointed at one end before hatching (Fig. 1*d*), the shell splitting across and the severed sides rolling toward each other when vacated (Fig. 1*e*).

Larva.—When newly hatched, pale orange-red, 0.14 mm. long, ovoid, the body with but three transverse sutures, one anteriorly, one between first and second, and another between second and third pair of legs; dorsum with several transverse rows of about six piliferous points; head somewhat narrowed, showing four minute swellings, each giving rise to a rather long hair; mouth-parts small and indistinct, with a dusky, granular spot at their base; legs 6-jointed, inclusive of fixed coxal piece, the third joint longest, hind pair somewhat longer than the others; all tipped with two well developed claws, those on front pair the longest; what appears to be a rudimentary sub-cutaneous fourth pair; no anal setæ.

Full grown larva.—1.6 mm. long, with the whole body greatly distended and elongated, the elongation being principally from the posterior dorsal portion so as to bring to view four hairs at the end; body showing two principal transverse constrictions, one about the middle, the other above it, while the whole surface is finely andtransversely striate.

Pupa.—17 mm. long, one-half as broad. Either pale yellow or orange-red, polished, swollen and rounded anteriorly, more tapering posteriorly, the dorsum well arched; two transverse impressions, at first noticeable but subsequently obliterated; palpi and legs formed under the larval skin, their ends finally projecting from it and more or less free; traces of the shriveled larval legs widely separated.

Adult.—When first from pupa the color is orange-red, with a distinct transverse constriction about the middle, and a deep transverse impression in the broad fore part. The species is characterized by the palpal claw consisting of one large hook, with a second smaller one originating from its middle, and three stout spines from near its base, and by the thumb being of uniform diameter, armed with rather long hairs terminally, and reaching

[1] Suites à Buffon. Aptères, 1844.

to or very little beyond its tip; also by a sunken polished plate at the end of the body dorsally; the plate but sparsely covered with hairs, elongate, square in front and broadening behind. The legs have the terminal hooks very short and blunt, the front pair is longest, the second shortest. Hairs of body barbed, slightly curved and attenuated. The scissor-like mandibles are faintly toothed within. With age the color intensifies to scarlet, but the legs, palpi and ventral surface are always more pale and silvery than the superior part of the body. The male is smaller than the female, has more intense color, relatively somewhat longer legs, wih the body more pointed behind and more deeply constricted; the anal plate more narrow; ventrally his body is more distinctly constricted toward tip, and more deeply impressed longitudinally; also with the genital impression more distinct. His body becomes more creased and impressed with age, while that of the female becomes broader and more smooth and swollen. Average length of female when full grown about 3 mm.; male about 2 mm.

Widespread. We have it from Manitoba, Texas, various eastern States and from California.

In each of the two egg-masses we have examined, the number ranged between 300 and 400, the mass being irregularly globose, and the eggs but loosely adhering to each other. We have not been able to ascertain the exact length of time required for the full development of the larva after attachment, but it is brief and seldom exceeds a fortnight, while the final transformation after detachment occupies but three or four days. Though the motion of the swollen and detached larva is slow, the legs move about with considerable rapidity, yet in the gradual change to pupa they shrink and are partially drawn in. Since De Geer's time it has been known that some of the octopod mites are hexapods in their early life, and there can be no doubt but that all the *Trombidiidæ* have hexapod larvæ. In addition to the locust mite above described, we have found another larval form attacking the mature *C. spretus*. It is at once distinguished from the larva of *locustarum* by the more prominent head, by the longer, more slender legs which are 7-jointed, the joints increasing in length to the penultimate which is longest, and by the hairs, whether on the body, legs or palpi, being long, tapering and barbed. It is possibly the larva of a large species which we have called *Trombidium giganteum*, distinguished by the following characters:

Trombidium giganteum Riley.—Adult 8 mm. to 9 mm. long; pyriform, somewhat flattened; no pronounced constrictions, but

various dorsal irregularities, usually about five pairs of circular depressions connected by transverse ones on anterior two-thirds, and a triangular series posteriorly. Barbed hairs, long and tapering, but very dense and even. Color deep scarlet, the legs concolorous; eyes dark. Characterized by the penultimate palpal joint forming a single claw with a prominent notch, while the terminal thumb is large, extending one-third its length beyond the claw, clavate and with the inner side of its broad end flattened; the claw as well as the thumb having sparse hairs; terminal joint of legs squarely docked, with the claws reaching but little beyond the side.

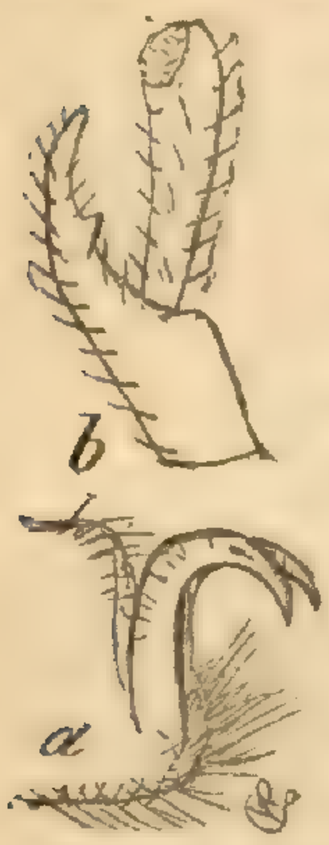

Fig. 3. — *Trombidium giganteum*; *a*, pedal claws; *b*, labial claw and thumb.

Living in the ground. Nine specimens examined.

We have also reared to the perfect state the well-known Astoma parasite that attacks the common house-fly (*Musca domestica*) in this country.

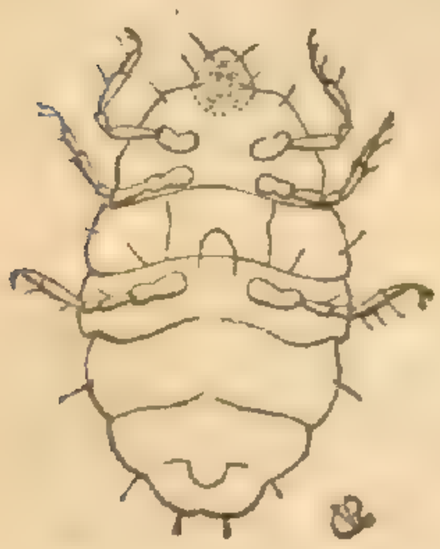

Fig. 4.—Larva of *Trombidium muscarum.*

The larva (Fig. 4) has the same mode of transformation as *T. locustarum*, but is much more active after detachment, while the gradual shrinking and withdrawal of the larval legs during the transformation to pupa is much more easily observed. The species is distinguishedfrom *T. locustarum* by the following characters:

Trombidium muscarum Riley.—*Larva* distinguished from that of *T. locustarum* by the greater relative length of legs, and by the hairs on the body being much longer and more conspicuous; also by the more distinct transverse sutures, of which there are four. Transverse striations noticeable soon after attachment. Full grown larva also more active.

Fig. 5.—*Trombidium muscarum*; *a*, labial claws and thumb; *b*, pedal claws; *c*, barbed tuberculous hair.

Pupa.—More rounded behind.

Adult.—Average length 1.2 mm.; color bright and pale scarlet; legs very pale and with the terminal joint fusiform and the claws much longer than in *T. locustarum*, and more nearly as found in the larva; body rounded, very little narrower behind, with no impressions or other marks. Barbed hairs of body sparse, short, blunt and tuberculous, giving a beautifully sprangled appearance under the microscope. Genital depression circular; penultimate palpal joint ending in two small, equal, blunt claws, the thumb being very small, tuberculous, and not reaching its tip. No marked sexual differences.

Many specimens examined.

The mode of growth of these mites may be more clearly illus-

trated by a brief reference to a common red water mite (*Hydrachna belostomæ* Riley) which we have studied. The mites of the typical genus *Hydrachna* are, in reality, the aquatic representatives of *Trombidium*, and have a precisely similar mode of development. We have not had the eggs, but in Europe they are known to be laid in spring, in holes in soft-stemmed aquatic plants.

The young larva (Fig. 6*b*) like that of *Trombidium*, is pale red, hexapodous, and with the legs 6-jointed, including the coxal joint. It has the mouth-parts retracted, and is characterized by two dark eye-spots anteriorly, and by the swollen second joint of

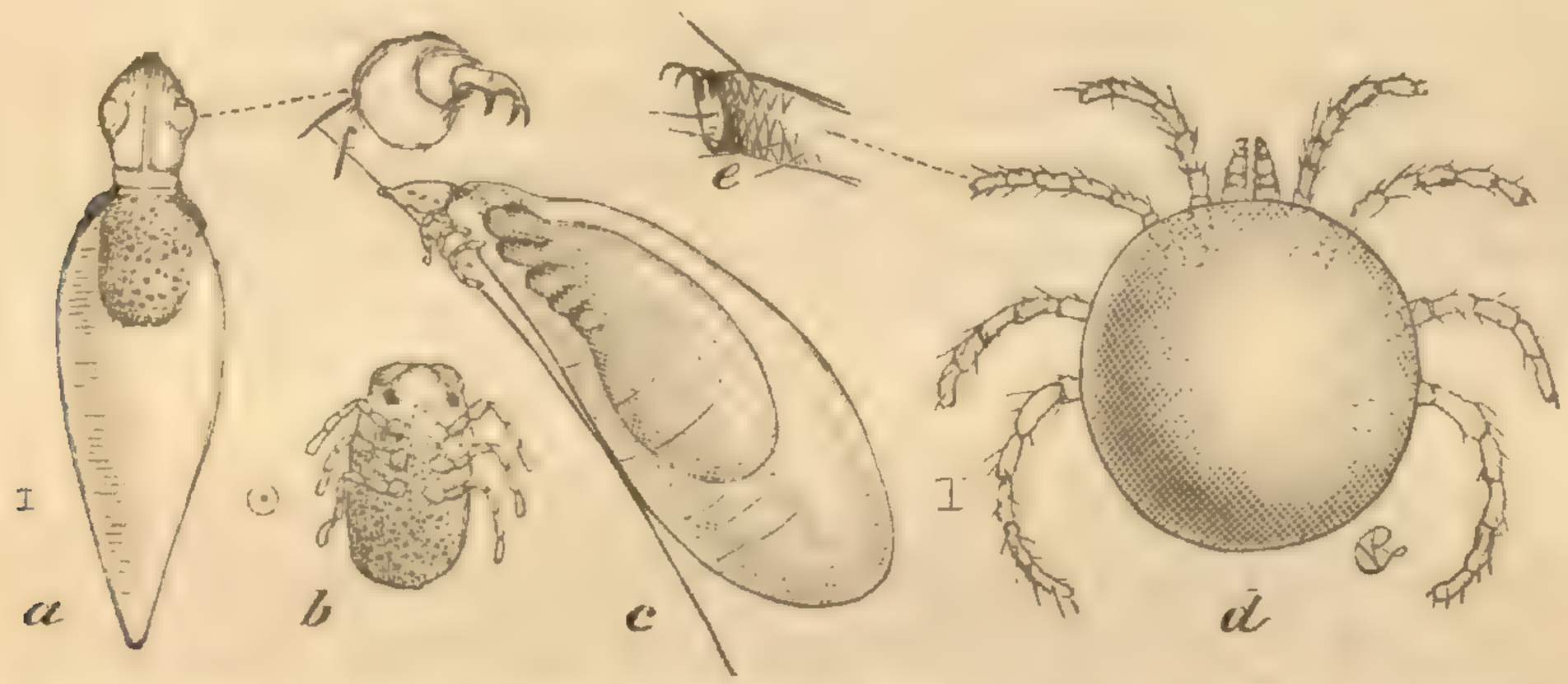

Fig. 6.—*Hydrachna belostomæ*; *b*, newly hatched larva; *a*, larva soon after becoming fixed; *c*, mature larva with pupa forming within; *d*, adult; *e*, its pedal claws; *f*, palpal claws of larva.

the palpi showing at each anterior corner. Moving about in the water these young larvæ fasten, often in very large numbers, to different aquatic insects. Water bugs of the family Belostomidæ are particularly subject to attack, and especially *Zaitha fluminea* (Say[1]), upon a single specimen of which we have sometimes counted over 500. They are able to fasten to the bug by means of several sharp hooks at the end of the palpi. Once fixed, the head and mouth parts stretch until they become separated by a neck from the main body, the transparent skin of which rapidly swells and elongates so as to form a bag with the more solid, dark-red parts visible anteriorly. (Fig. 6*a*.) The maxillæ penetrate and extend beneath the chitinous covering of the host, until they form a long pointed thread. The legs curl up, become useless, and are more or less withdrawn, and the larva gradually passes to the pupa state within this bag, which becomes more and more swollen and rounded posteriorly, and finally bursts to release the adult mite. This bag-like larva was looked upon as

[1] *Perthostoma aurantiaca*, Leidy.

an egg by many old authors, and was made the type of the genus *Achlysia* by Audouin.

The adult swims actively about in the water, but before attaining maturity fixes to some plant and undergoes another molt without material change of form.

Hydrachna belostomæ Riley.—*Larva.* Hexapodous. Elliptic-ovoid. Pale red, with two dusky eye-spots. Legs 6-jointed including coxæ; terminal joint longest; claws very small. Surface closely and evenly studded with minute points. Palpi drawn beneath the head with the second joint greatly swollen, and showing like an eye at each anterior side of the body; the three terminal joints indistinctly separated and each armed with a sharp hook. Becoming elongate and more or less pyriform, with a distinct neck when fixed. *Pupa* formed within the bag-like body of larva. *Adult*—Average length when first from pupa 1.5 mm.; globular; color dark blood brown; body smooth; legs with but few hairs, terminal joint truncate and with two very minute claws; palpal claws very small and the thumb no longer.

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THE HOME OF THE HARPY-EAGLE.

BY FELIX L. OSWALD, M.D.

NOT far from the old military road which unites the Mexican seaport of Tehuantepec with the cities of the table-land, there stands an ancient Spanish fort, *El Fortin de Tarija*, which is now used as a storehouse by the proprietors of a neighboring copper-mine, while one of the larger outbuildings has been converted into a tavern, where the stage coach stops for dinner. *Posada de dos mares*, Hotel of the two seas, seems rather a strange name for a posada situated in the heart of the Sierras, and at an elevation of at least twelve thousand feet above the level of any sea, but if the traveler deigns to alight and share the *table d'hôte* of the humble posadero he may convince himself that the name is not so very inappropriate after all.

"Forty minutes time before the coach starts Señor," my host will observe after dinner, "and if you never passed here before, perhaps you would like me to accompany you to the Fort and show you the *alta vista*, the grand view, from the parapet."

"Grand view? is there anything exceptionally grand about it?"

"Yes, sir, it is the grandest view in America, for you can see

los dos mares, the two oceans, at the same time! I only charge you one real (twelve cents) extra."

He who has never seen two oceans at the same time will very likely invest a real. The view is grand indeed. You stand on the back-bone of the American continent, which measures less than two hundred English miles from shore to shore here, and see the Gulf of Mexico so plainly that you might distinguish the smoke-trail of the New Orleans packet, or the glittering towers of St. Juan de Ulloa, while the Pacific, though thirty or forty miles nearer, glistens faintly through a gap of the Chiapas coast-hills, and but for the sharp-drawn line of its horizon might be mistaken for a mountain lake. Yet it is not the water that constitutes the grandeur of the *alta vista*, it is the land, the main-land of the western world, of which you see a larger and fairer portion from the parapet of Fort Tarija, than from perhaps any other point between Mount St. Elias and the Peak of Aconcagua. Far from the north, from the distant border state of Sonora, descends a mountain chain which is easily recognized as the Sierra Madre, the main and central chain of the American continent, the southern prolongation of the Rocky mountains of New Mexico and Colorado. A second Sierra, a continuation of the California Contra-costa range, lifts itself in the north-western sky, and may from here be traced through a succession of fainter but snowier summits that seem to rise with the distance, till they culminate in a stupendous peak, the extinct volcano of Culiacan, which looms like a jagged white cloud over the edge of the horizon. About ten leagues, or thirty English miles, from the Fort the two Sierras unite, and between their icy ridges, their wild crags and their forests of evergreen pines enclose a mountain-land which is perhaps, after all, the true paradise of the western hemisphere.

From the regions of eternal snow to the lakes and fruit-groves in the valleys that communicate with the primeval forests of the *tierra caliente*, this vast triangular terrace-land, the great mountain valley of Oaxaca, exhibits every degree of elevation, the climatic extremes with all their intermediate grades and almost every variety of the American fauna and flora. On a surface of six thousand English square miles the eastern half of the state of Oaxaca unites a greater abundance and variety of animal and vegetable life than any other American country of equal extent,

and the exuberant fertility of its lower valleys is only equaled by the coast regions of the Sunda islands. Life seems intensified here. The mightiest trees and the strongest animals, as well as the sweetest fruits and most brilliant birds, are found together in this garden of the Hesperides, which (from all but a political standpoint) would appear, even to a patriotic Yankee, as superior to the finest portions of the United States as the hill counties of Southern Tennessee are superior in beauty and fertility to the most favored districts of Labrador.

Between the two main forks of the Rio Verde, and within a circuit of fifty English miles, the naturalist may find from sixty to seventy-five different species of palm trees, wild growing oranges, figs and almonds, four varieties of the *Musa paradisiaca;* the Adansonia and the dragon-tree, with their gigantic trunks, the most gorgeous butterflies, the largest reptiles and Carnivora of the New World, including the *Boa imperator* and the jaguar, and the strongest if not the largest of all American birds, for the forests of Southern Mexico are the favorite home of the Harpy-Eagle, the king bird of our western continent.

Even animals of a wide latitudinal distribution show an elective affinity for some special country which may have been their "centre of creation," and has always remained their favorite abode, where they will survive after their species has become extinct in other lands, and which may, therefore, be called their home *par excellence.* The tiger is thus at home in the Sunderbunds of the Ganges Delta, the bustard (*Otis tarda*) on the plains of Southern Russia, the flying squirrel in the Southern Alleghanies, and the prairie dog in North-western Texas, near the head waters of the Red River. The harpy-eagle (*Harpyia destructor*) has been shot in the mountains of South-western Bolivia, in the Mornes du Diable of St. Domingo and in the valleys of Southern California; but a hunter may range those regions for years without getting a chance to add to his trophies the feather coronet of the *aguila real*, the king eagle, as the Spaniards call him, while every farmer's boy of an Oaxaca mountain village knows an eyrie or two in the neighboring crags, which he is ready to rob of its eaglets or large white eggs for a couple of reals. From the projecting rocks of the lower Sierra, on any bright morning of the year, one may see the hovering form of the destructor suspended in the clear sky or wheeling in ascending circles over the misty ocean of foliage.

and from March to the end of June the tree-tops of the *tierra caliente* resound with the screams of the ever-hungry eaglets.

In the spring of 1875, I sent a pair of callow harpies to Messrs. McAllister & Co., of Vera Cruz, who took them to Philadelphia the next year, where one of them is now, while the other found its way to New York. They were the first living birds of their species that ever reached our Eastern States, I believe, with the exception of a wounded old hen-harpy of extraordinary size, that was shot and captured near Tampico by Colonel Godolitz, of the Austro-Mexican army, who took her to St. Louis, Mo., where she died soon after her arrival, either from her wounds or from the effects of the climate. A so-called harpy, which is kept in the Zoölogical Garden of Munich, I found to be a Brazilian eagle (*Polyborus tharus*), which, properly speaking, is no eagle at all, but like the *Læmmergeyer* of Switzerland, a compromise between the *Falconidæ* and vultures. None of the repeated attempts to carry the genuine harpy-eagle to Northern Europe has succeeded, as far as I know; owing more probably to its sensitiveness to cold than to its impatience of captivity, for the *aguila real* is a common pet in the farmhouses of Southern and South-western Mexico.

On the hacienda de Tuxpan, the hereditary estate of the Santa Anna family, I saw among other curiosities a tame eagle, which had been kept in and near the house for upwards of twelve years, and had been so much indulged in all its whims that it had come to consider itself as a privileged member of the household. It was a fine specimen of the genuine crested king-eagle, and gave me the first opportunity to study the physical and moral peculiarities of the species.

The *Harpyia destructor* is well equipped for its trade. A square, strong head, armed with a most viciously curved, powerful bill, that can crush a man's finger-bones without any special effort and dislocate the neck of a squirrel-monkey by a single wrench; broad compact wings, moved by shoulder-muscles of enormous strength, and a pair of stout legs, feathered to below the tarsi, that terminate in claws of such extraordinary power and sharpness that they leave marks on the skin of a quadruped and even on the tough leather of a Mexican saddle like the bite of a wild-cat. The harpy is often killed for the sake of its feathers, I mean for the feather-bed value of its plumage, by the Mexican Indians,

and if plucked, yields about four pounds of soft, grayish-white down, beside the stiff wing and tail feathers and the bristling tuft which crowns its head. This plumage is so elastic, so compact, and so firmly imbricated that buckshot, striking the wings or the breast of the bird at a certain angle, glance off or fail to penetrate to vital parts; and monkeys or foxes which in their death struggle snap at what they mistake for the throat of their captor, shut their fangs upon a mass of elastic down, which baffles their efforts till the grip of the destructor closes upon their own throats. The harpy can overtake the swiftest birds of the tropical woods, and, in spite of its size, steers its way through the labyrinth of forest trees and hanging vines with amazing skill, and rarely fails to rise with a pheasant, a woodcock or a small mammal in its claws after plunging like a meteor from the clouds into the leafy maze of the *tierra caliente*.

The full-grown eagle walks in stiff grandezza, with its head erect and its crop thrown out, after the manner of strutting turkey-cocks, except, if charging an enemy, when he lowers his head like a vicious buck, half opens his wings and rushes to the encounter with a succession of flopping jumps. The old hen-harpy measures about three feet from its crest to the base of the tail, and from six to seven feet with outstretched wings. The male is somewhat smaller, but the strength of the bird in proportion to its size is altogether abnormal. It has been said that a bulldog is readier to fight an antagonist of superior bulk than any other animal; and speaking merely of the courage to attack a foe without regard to his size, this is probably true, for, at the bidding of its master, an English bull-terrier will charge a beagle or a bear with equal promptitude, but if we speak of the ability to vanquish as well as to assail larger animals the first prize belongs indisputably to the *Harpyia destructor*.

The *lobo volante*, or winged wolf, as Quesada translates the old Aztec name of the harpy, attacks and kills heavy old turkey-cocks, young fawns, sloths, full-grown foxes and badgers, middle sized pigs and even the black Sapayou monkey (*Ateles paniscus*), whose size and weight exceed its own more than three times. The old eagle on the hacienda de Tuxpan engaged, not in a friendly bout, but in mortal combat, the big shepherd's dog of a neighboring farmer who visited the hacienda now and then; and was only vanquished by a second dog that came to the aid of

his brother. The colly, who looked as if he had encountered a pack of wolves, managed to limp off, but on his way home dropped by the roadside, *exsanguis*, and a *post-mortem* examination showed that he had bled to death from a deep gash in his throat, that one of his eyes had been torn out, and that in the fight of ten minutes the bones of his skull and breast had been laid open in as many different places.

At the return of President Juarez to the Mexican capital in 1867, the festive bull-fights were supplemented by various side-shows, and in the vestibule of the Grand Arena a pugnacious old cock-harpy was pitted against a Mexican lynx (*Felis onca*), which had been crippled by a shot through its haunches, but was otherwise in good fighting trim and very much inclined to take satisfaction out of somebody. The bird was torn to pieces; but the mammal did not survive him many minutes, having been literally flayed from its shoulders to the tip of its nose.

Professor Buckley, State Geologist of Texas, told me that he shot a harpy in the jungle-delta of the Rio Grande, but failed to capture it, though both its wings were broken and the blood issuing from its beak gave proof of severe internal injuries. In this crippled condition the bird kept the dogs at bay by turning on its back and presenting its claws after the manner of a wounded cat, shuffling off at the same time by an alternate movement of its neck and tail, till it reached the edge of the jungle, into which it disappeared before the hunter had reloaded his shot-gun.

The organ of vitality, which, according to Lavater's definition, inspires a tenacious adherence to life, must occupy a large portion of the harpy's brain, and enable it to survive injuries which would terminate the nine lives of the most vigorous tom-cat. No Mexican hunter of experience will waste ammunition by a long-range shot at a crested eagle, for unless the bullet shatters his head or breaks one of his wings, the bird flies off as if nothing had happened, though a cloud of feathers flying from his breast or abdomen may attest that the shot has not missed altogether. A Mexican miner who left the blast furnaces of St. Miguel, near Orizaba, before day-break one Sunday morning and descended the mountains by a short-cut, surprised a pair of harpies on their eyrie, and with a common cudgel knocked down one of them, which, either to scare the intruder or because it was scared out of its own wits, flew directly at his head. The bird flopped

among the boulders, but before it could take wing again, the miner put an end to its struggles with a few well-aimed whacks, and shouldering his game, resumed his road towards the valley settlements. Half-way down the hill he reached a steep cliff and shifted his burden to his left shoulder, to use his right arm to better advantage. But at the most critical moment of the dangerous descent he suddenly felt the claws of the eagle at his neck, and, in order to save himself, had to drop his stick, which fell down the cliffs and into the bed of a mountain torrent. Holding on to the bird with one hand, he managed to reach the foot of the precipice, where he seized the struggling captive by the legs, and swinging it up, dashed its head against a rock, till its convulsions had ceased entirely. His arrival in the village with the story of his adventure, created quite a sensation, but when the bird was deposited on the ground to be examined at leisure, it revived for the third time, struck its claws through the hand of its captor, struggled to its feet and would have escaped after all, if the enraged miner had not flung himself upon it, seized a rock and hammered its head to a jelly.

As soon as the lengthening days of the year approach the vernal equinox, the hen-harpy begins to collect dry sticks and moss, or perhaps only lichens with a few claws' full of the feathery bast of the Arauca palm, if her last year's eyrie has been left undisturbed. Her favorite roosting places, the highest forest trees, especially the *Adansonia* and the *Pinus balsamifera*, and the more inaccessible rocks of the foothills, are commonly also chosen for a breeding place, and it is not easy to distinguish her compact-built eyrie on the highest branches of a wild fig-tree from the dark-colored clusters of the Mexican mistletoe (*Viscum rubrum*), which frequents the same tree-tops. The eggs are white, with yellowish brown dots and washes, and about as long, though not quite as heavy, as a hen's egg. Of these eggs the harpy lays four or five, but never hatches more than two, or, if the Indians can be believed, feeds the first two eaglets that make their appearance with the contents of the remaining eggs. The process of incubation is generally finished by the middle of March, if not sooner; and from that time to the end of June the rapacity of the old birds is the terror of the tropical fauna, for their hunting expeditions which later in the year are restricted to the early morning hours, now occupy them for the larger part of the day.

From the garden-terrace of *El Pinal*, a little villa on the ridge of the Organos mountains, I frequently watched a pair of harpies that had their nest in the crags below. The hen-bird, which could be recognized by her larger size and the greater energy of her movements, generally made her appearance a few minutes before sunrise, mounted to the upper sky, as if to study the meteorological probabilities for the coming day, and then proceeded to business. After wheeling at an elevation of some hundred feet over the tree tops, in a circle or rather in a contracting spiral for a couple of minutes, she commonly would stop short, hover with quivering wings for a second or two, and then dive into the leafy ocean below, with a headlong rapidity that could hardly be followed by the eye, but evidently with a practical purpose, for her descents were generally succeeded by the ascent of a cloud of birds or the shrill piping of the squirrel-monkeys (*Callithrix sciureus*) and the exultant scream of the wild huntress from the depths of the forest. Then followed a pause, devoted to domestic duties, during which the thanksgiving duet of the eaglets ascended from the cliffs, and very soon after one or both parents reappeared in the upper air to resume the work of destruction.

The callow harpies, with their pendant crops, their misshapen big heads and their preposterous claws, resemble embryo demons or infantine chimeras rather than any creatures of nature, but they grow very rapidly and their appetite during the first six months of their existence is almost insatiable. The pair which I afterwards sent to Vera Cruz kept an Indian boy busy from morning to night, cleaning their cage and refilling their trough with a ragout of fish, pork and hominy. The exigencies of two or three harpy-nests to the square league, which I take to be the average ratio of their distribution would exhaust the food supply of any other region but that of a tropical jungle, and even there the eaglets would have to be stinted in the rainy season, if it was not for the harpy-eagles' impatience of any competition. His tyranny over the kingdom of the air tolerates no rival; the falcons and the *Aquila chrysaëtos* have to confine themselves to the icy rocks of the upper Sierra, the *Strix bubo* and other owls are bound under heavy penalties to keep the peace during daylight and the sea-eagle is pursued for miles with implacable fury whenever he ventures to trespass upon the rivers of the *tierra caliente*.

Of all the *aquilinae*, the harpy is the only one that tolerates no interference with his business by jackdaws, jaybirds and other police agents of the woods. In his excursions to the upper mountain forests he is often attacked by swarms of the iris-crow, the sworn enemy of the falcon kind and all other *Raptores ;* but, unlike the others, the harpy invariably turns upon his pursuers, and by capturing and tearing one or two, greatly moderates the zeal of the others.

In the choice of his game he shows a great latitude of taste and seems to devour with equal relish a fat iguana-lizard, a young woodcock or a tough old monkey. During the wet season, when pheasants won't break cover and squirrels stay at home, the *Harpyia destructor* may often be seen perched on some overhanging bough at the edge of a lagoon or large river, in wait for waterfowl. If you can watch him unobserved, you may see him get ready if the squawk of an approaching string of wood-ducks resounds from the depths of the everglades. He half opens his wings, bends his head up and down so as to put his perch into a rocking motion, and then leans forward like a catamount preparing for a spring. As soon as the unsuspecting mallards have passed his tree, he flings himself ahead, with wings laid back and claws ready for action and shoots like an arrow between the water surface and his game, thus getting them completely at his mercy. After rushing forward in blind obstreperous flight for a few hundred yards, the frightened ducks resign themselves to their instinct, which guides them waterwards ; but before they touch the saving element the harpy is in their midst, with time enough and to spare, to make a judicious selection. He can catch fish, too ; does not disdain the black watersnakes that glide through the shallow ponds of the coast-jungles, and even anticipates the trick of the tortoise hunters that uncover the oily eggs which the carey turtle has covered with the sand of the shallow river banks. But during the larger part of the year he seeks his quarry on the trees of his native woods, and causes more distress and dire commotion among the tribes of the gallinaceous tree birds, raccoons, frugivorous rodents and monkeys than all their other enemies taken together.

The upper branches of the tall mango trees which are visited by swarms of Sapajou monkeys during the fruit season, become the scene of a horrible hubbub if one of the wary quadrumana espies the hovering form of the arch-fiend, getting ready for the

first act of an oft-repeated tragedy, and gives the alarm signal by a coughing scream, followed by the yells and confused chattering of the entire party. They huddle together like a flock of frightened sheep, the mothers especially endeavoring to push their babies into the centre of the crowd; but in the midst of the preparations the screech of some outpost gives the signal for a general *sauve-qui-peut*—the murderer is upon them, has grabbed some unlucky youngster between neck and skull and flies away, with the switching tail of the captive depending from between his claws, while the pitiful piping of the bereaved relatives mingles with the grunts of execration of the old patriarchs. The whole assembly then repairs to the upper branches for a chattering indignation meeting.

A struggling monkey generally throws its hands up, and by thus losing its hold upon the branches, gives the enemy a fatal advantage; but the large bluish-gray squirrel of the Mexican woods (*Sciurus gigas*), if pounced upon so unawares that it has no time to regain its hole, either throws itself headlong to the ground or jumps toward a stout bough, takes hold with its four legs and four teeth at once and never loosens its grip while a spark of vitality remains in its claws or jaws. The harpy then either devours his prey *in situ*, by tearing piece after piece from the quick body, or relaxes its hold and takes wing for a moment, which often betrays the squirrel into the imprudence of letting go and taking a flying jump into space, in the hope of reaching the ground, where it would easily escape in the thick underbrush. Anticipating this, the eagle has perched upon a lower branch, with his wings half open, and intercepts the *salto mortale* by catching the jumper in mid-air.

During the sultry hours of the early afternoon the harpy-eagle participates in the general siesta, and may often be seen perched upon a lower branch of the *caucho* or some other dense shade-tree, alone or in company of his mate and the eaglets of the last brood. Swaying from side to side and crooning to himself in a sort of snoring or murmuring purr, he sits thus for hours, enjoying the sweets of digestion, till the lengthening shades and the reawakening voices of the forest summon him to supper or to one of those aerial excursions in which a pair of breeding harpies joins toward sunset as often as in the early morning hours.

The Incas and Aztec noblemen trained harpy-eagles like

falcons, and preferred them to tame panthers, which were used by pot-hunters to capture deer and young peccaries. Devega, the biographer of Hernan Cortez, says that the satrap of a Mexican province presented the Great Captain with a hunting-eagle, called *El Hidalgo del aire*, the prince of the air, whose value was estimated at the price of ten slaves; and adds, that the only bodily injury which Cortez ever received during his adventures in Mexico, was inflicted by this eagle. The cruel Spaniard used to prick the bird with his dagger, because he would not obey the hood, *i. e.*, did not wait for the signal of attack, as the Castilian gerfalcons were taught to do, and once, when the eagle repeated this error and took wing without proper authority, the angry hunter sent a pistol ball after him, "to teach him manners." The shot cured him of his bad habits forever, for it broke his head, and the prince of the air tumbled down with his talons quivering in the death shudder. Cortez dashed his pistol to the ground and knelt down in the hope of saving the victim of his passion; but Hidalgo was booked for the happy hunting grounds. Three or four times he tried to rise to his feet, and then lay still, his strength ebbing away with his life blood. But before he resigned himself to death, he raised his head once more, grabbed the best finger of the right hand of his cruel master, and bit it through--crushed it completely, "so as not to leave the world unavenged," as Devega says.

The Princes of Tlascala wore the image of the crested eagle on their breasts and on their shields, as a symbol of royalty, and could not easily have chosen a fitter emblem. The *aquila real* does not wear his crown in vain, he is a true monarch and embodies all the ideal characteristics of a wild warrior. Proud, strong, swift, wary and bold to a surprising if not to a sublime degree, he meets no superior but the omnipotent biped that has not inappropriately been called the god of the animal world, and among the tribes of his own element he recognizes neither a chief nor a rival. The tropical forests between the Gulf of Mexico and the head-waters of the La Plata are his domain, and he has chosen his home well. There will be forests and game and wild liberty in those regions after the last wilderness between Texas and Labrador has disappeared and all Northern America is either a treeless waste, like Turkistan, or a hive of industry like Germany and Great Britain. The continuous woods that once cov-

ered Europe from Portugal to the foothills of Caucasus have disappeared, the mountains of Persia have become naked rocks and the promised land is a desert; but the Sunda Islands, Southern India, Siam, Ethiopia and the birthland of the Nile are still as sylvan and as prolific of life as in the springtime of creation. Not only the ocean but the vegetation of the tropics can defy "the vile strength, which man for earth's destruction wields," and Macauley's New Zealander who might visit the desert relics of American cities after musing over the ruins of London, would still find the primeval forests that covered the southern part of our continent when Humboldt and Bonpland explored the valley of the Amazon.

"These forests will be felled," says De Tocqueville, speaking of the Calaveras cedar groves, "they will disappear as the cedars of Lebanon and the mountain-firs of Scotland have disappeared; these and all other forests of the cold and temperate zones. The trees of the tropical woodlands are the only true evergreens on earth."

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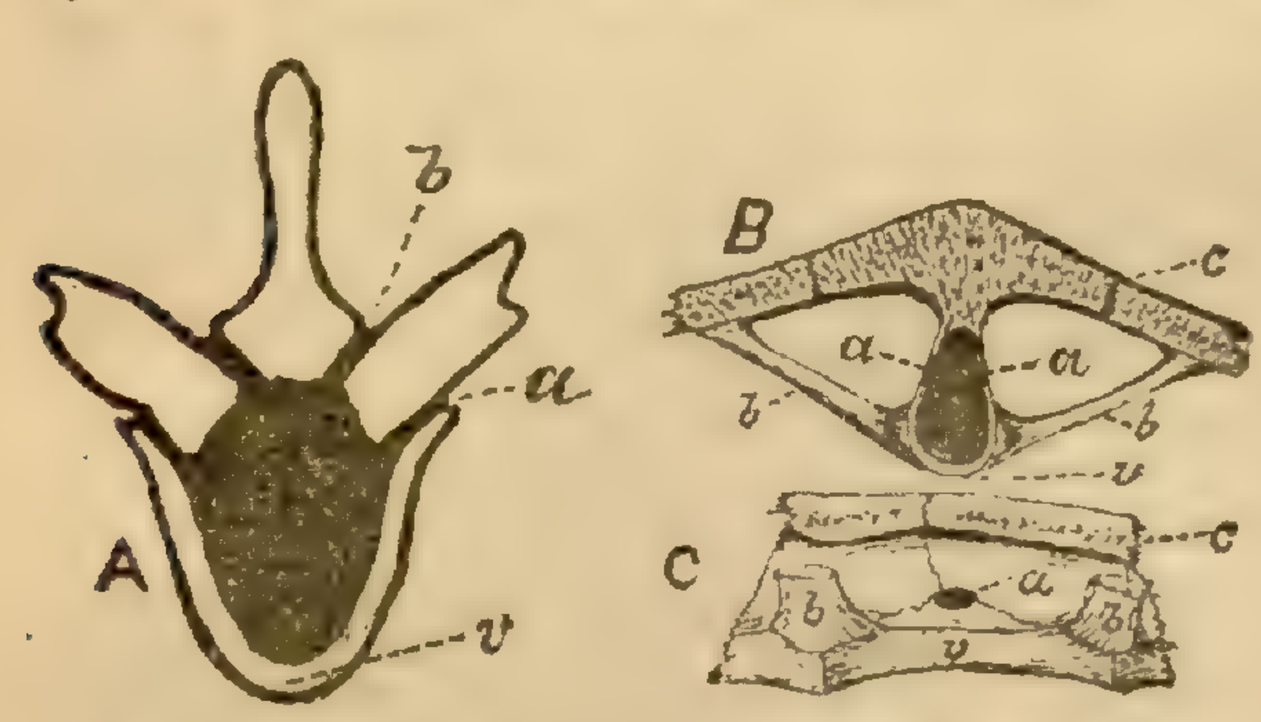
ON LIKE MECHANICAL (STRUCTURAL) CONDITIONS AS PRODUCING LIKE MORPHOLOGICAL EFFECTS.

BY JOHN A. RYDER.

APROPOS of the interest recently manifested in the matter of "the relation of animal motion to animal evolution,"[1] I have thought it pertinent to offer the following remarks. The possible morphological effects of like mechanical or structural conditions are illustrated in the vertebral axes of turtles and extinct armadilloes (*Hoplophoridæ*), where the rigid exoskeleton (carapace) has caused the originally segmented axial skeleton to exhibit a strong tendency to revert to the primitive homogeneous (notochordal) condition, without at the same time losing its osseous character. The exoskeleton in both these groups has assumed in part the function of the chitinous exoskeleton of articulates. The vertebral axis relieved in both instances from the transverse flexures incident to locomotion and respiration, has coössified into a solid bony bar, or rather a hollow tube, with loss of the cylindroid form of centrum. The vertebral centra are in both represented

[1] See E. D. Cope in this Journal for January, 1878.

by the inferior wall of the "dorsal tube," *v* in the cut.[1] The extremital portions of the axes in both, manifest more or less distinctly the action of flexion in preserving the axial elements separate, since, in the necks and tails of both, there still remains more or less of mobility. In both, the union of the vertebræ has resulted in a similar disposition of the lateral foramina for the exit of the spinal nerves, that is, these open midway of the length of the vertebræ, piercing the lateral wall of the dorsal tube, and not passing out laterally between the bony arches of the neural canal, as happens in other vertebrates (see A, *a*, B, *a* and C, *a*, of cut). The reduction of the centra in the higher tortoises is, as should be expected, much more manifest than in the lower forms, and the union with the carapace, though not extensive, is manifested in the armadilloes by sutural union in the lumbar region. Similar structural alterations, which are believed to be similarly due to alterations in the mechanical relationship of the skeletal elements, are to be observed in the sacra of birds and mammals where the ilia have been greatly elongated so as to prevent lateral flexures of this portion of the column. The ribs in turtles have been involved in the dermal ossifications, and are therefore, as should be expected (B, *b* and C, *b*), united to the vertebral axis by suture; this is not the case in the *Hoplophoridæ*, where, owing to the preservation of the more highly specialized mammalian respiratory apparatus, the vertebro-costal articulations are still preserved, with loss in large measure of movement in an outward direction of their sternal ends. The costal movement was probably from behind forwards, with return, since the only articulation of the thoracic axial skeleton which is preserved, is that between the twelfth dorsal vertebra and first lumbar. *A priori* we should expect the phylogenetic history of the vertebral axes of the order



A, transverse section through the "dorsal tube" of *Panocthus tuberculatus*, reduced, after Burmeister. B, the same through the dorsal region of a salt-water terrapin (*Malacoclemmys*), original. C, side view of dorsal vertebra of *Emys europæa*, after Bojanus.

[1] A similar degeneration and anchylosis of the centra is observed in the cervical vertebra of *Dipodomys*, as I have recently ascertained from a specimen sent me by Dr. Coues.

of Chelonians to agree with ontogenetic history or embryology of the individuals of the highest family. This, so far as I have been able to make investigations, proves, in a measure, to be the case, for it is observed that that portion of the vertebral axis included within the carapace in a young *Cistudo* has the vertebral centra more nearly of the character of the same parts of the lowest turtles, which approximate in the development of their centra to the normal or usual types of vertebrates with segmented axes. The degeneration of the vertebral axis in *Cistudo* into a mere tube, with exceedingly thin walls for the lodgment of the spinal cord, may probably be regarded as an instance of Cænogenesis.

These observed coincidences, it is believed, are neither accidental nor designed by an active cause external to these organisms or their cosmic environment. I would rather believe that the structures, so far as they have been evolved in parallel or similar ways, are the results of like forces conditioning growth and nutrition in definite modes and determinate directions. The manner of incidence of the modifying forces being in all cases determined by the voluntary actions of the organisms; the actions in turn are determined by the degree of intelligence of the animal manifesting them.

The origin of dermal ossifications is to my mind rationally explained by supposing the bioplasm of each dermal cell as sensitive and irritable to rude or violent external impacts, which, oft repeated, act as stimuli of growth force, determining certain tracts of these cells as the nidus within which osseous particles eventually appear as nuclei of the future defensive dermal bony system. This happens in the true skin and not in the corneous epiderm, which is still retained in more or less rudimentary condition in both Chelonians and Armadilloes, though it is not to be forgotten that in the toothless old-world Edentata it is the epiderm which becomes the defensive covering. This thickening, though not depending upon peculiar movements of portions of the body, as in the origin of hoofs, horns, etc., of other forms, depends upon the motion of the whole body mass, during which the hurtful stimulating impacts with the environment take place; so that the *rationale* of the origin of dermal ossifications is finally resolved into terms of osteoblasts and animal motion. The likeness of the process of the evolution of a defensive osseous or corneous derm, as sketched above, to the process of reparation in wounds is very

great, indeed, in no essential are they different, except that the former usually goes forward in a bilaterally symmetrical way, while in the latter it most frequently does not.

The preceding facts and considerations embrace what may be regarded as the complementary principle demonstrating the mechanical theory of axial segmentation or origin of vertebræ, as proposed by Spencer, since it must be allowed, that if segmentation is due to flexures of the vertebral axis, conversely, union, coössification of segments, is due to their absence, because opposite conditioning causes must produce opposite effects in two things respectively so conditioned.

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ON THE TRANSPIRATION OF PLANTS.[1]

BY J. M. ANDERS, M.D., PH.D.

IN looking over the literature of the subject, one is surprised to find how little definite knowledge we possess in regard to the process of plant transpiration. When the importance of the subject is considered, there would seem to be no explanation for this apparent omission of research.

It has been pretty well established that transpiration is produced and modified by influences acting from without, and by the structural peculiarities of the plant. Most important among the former modifying agencies are sunlight, wind, dew point and temperature ; and among the latter circumstances is to be mentioned, more particularly, the nature of the epidermal tissue. The precise connection between these various conditions and the amount of water evaporated has not been investigated to any considerable extent; and the most important question, viz.: the amount of liquid ordinarily transpired by different plants has, also, hitherto been quite as sadly neglected.

A few bare statements are made in relation to the quantity of transpiration (Gray's Structural and Systematic Botany). A sunflower 3½ feet high, with a leaf surface of 5616 square inches, when exposed to the air, evaporated from 20 to 30 ounces in twelve hours, being seventeen times as fast as man exhales. A seedling apple tree, with leaf surface amounting to 112 square feet, evapo-

[1] The Geo. B. Wood prize essay, 1877, read before the Society of the Alumni of the Auxiliary Dept of Medicine, University of Pennsylvania.

rated at the rate of 9 ounces per diem, and a vine with twelve square feet of leaf surface, transpired at the rate of 5 to 6 ounces per day. The sunflower during a dry night lost 3 ounces, but nothing on a dewy night. The method adopted in these experiments is not referred to by him.

Balfour, in his work on botany (page 457), refers to the investigations of Woodward, giving some of the results of this observer. Woodward took plants, and, having immersed their roots in water, placed them in the light for more than a month. He noticed the quantity of water absorbed and the amount transpired (making allowance for extraneous evaporation), and showed that the greater quantity of the water absorbed was again given off by the leaves.

It is questionable whether results thus obtained are to be relied upon, inasmuch as these plants must have been placed under unnatural conditions and influences, by allowing their roots to rest in pure water; for it is a known fact that certain plants (Calla Æthiopica, for instance) can be made to distill the water in drops from their leaves, if too abundantly supplied to their roots.

Curiously enough, in every instance in which the methods adopted have been detailed, the objectionable circumstance of placing the plants in a very unnatural state while experimenting upon them has obtained. Reference is here made only to experiments on entire plants. The results of the observations of Garreau (Annales des Sciences Nat. 3d Ser. Bot. xiii. 355) on the transpiration from leaves should, doubtless, be accepted as reliable, if we consider the means employed. This observer estimated the amount of exhalation by collecting it by means of chloride of calcium, placing the leaf between two bell-jars, one applied to its upper and the other to its under surface. His conclusions were:

"1. The quantity of water exhaled by the upper and under surfaces of the leaves is usually as 1 to 2, 1 to 3, or even 1 to 5 or more. The quantity has no relation to the position of the surfaces, for the leaves when reversed gave the same results as when in their natural position. 2. There is a correspondence between the quantity of water exhaled and the number of stomata. 3. The transpiration of fluid takes place in greater quantity on the parts of the epidermis where there is least waxy or fatty matter as along the line of the ribs."

Among the reported results that my eye has been able to reach, the foregoing only are considered worthy of special notice. Possibly some have escaped notice.

The present experiments have been performed more especially with the view of ascertaining, as nearly as possible, the amount of water evaporated by plants in a healthy, natural state, and, also, to determine the connection between the meteorological conditions and variations and the nature of the cortical tissue, and transpiration. The importance of keeping the plants in a perfectly normal state while being experimented upon was called attention to by Prof. Rothrock when lecturing on the subject of evaporation from plants. To accomplish this it was suggested by him at the time that something impervious to moisture be adjusted to the receptacle in which the plant had previously been growing, fitting the same accurately to the base of the stem, the object of it all being to prevent any evaporation from the vessel or earth in which the plant was situated, so that all evaporation would be from the plant itself above the ground. The plant was now to be weighed at stated intervals and the loss of weight in any given time would represent the weight of the liquid transpired. It is evident that this, with properly balanced scales, would show exactly the quantity evaporated, save the slight increase in weight of the plant by the gases derived from the air which it fixes in the time of one experiment. This certainly must be regarded as extremely small when we reflect that plants return to the atmosphere the greater portion by volume of the gases absorbed by them. The circumstance of plants gaining slightly in the course of a day by the gases they fix from the air, it will be observed, is not calculated to favor an over-estimate of the quantity transpired.

The means employed to accomplish these ends were as follows:

A piece of good rubber cloth of sufficient size was taken and its narrower border tucked up neatly around the base of the stem of the plant and secured by means of an elastic cord. The rubber cloth was then allowed to drop down over the vessel in which the plant was situated, the portion of the cloth underneath the pot gathered up and brought to one side of its base, and after giving it a few twists in one direction so as to insure its close application to all parts of the pot, the twisted portion was well wrapped and tied off by means of a cord so as to keep it in this condition. This

done, the line of separation at the point where the edges of the cloth met, was remedied by allowing an overlapping of two inches or more and sealing by means of gum mucilage. It was now thought that evaporation from the vessel in which the plant was situated was next to impossible; but the question next arose, "How is the plant to be supplied with the necessary moisture?" This difficulty was overcome by taking a hollow cylinder of tin 3-4 inch in diameter, and about 3 inches in length, and having made a hole of sufficient size in the cloth covering the pot, a few inches from the stem of the plant, introducing one end of this tube into the opening, the rubber cloth was tucked up and tied on it the same as in the case of the stem of the plant, the external opening of the tube being guarded by means of a cork.

It would be useless, as well as illogical to assert that this arrangement would allow of no escape of moisture whatever, yet there is perfect safety in affirming that the quantity thus lost sinks into insignificance compared with the amount actually transpired by the plant itself. The loss by insecurity of this method could certainly not exceed a few grains per day.

The plants were watered in the morning before weighing them for the day's experiment, and just sufficient water was given them to keep them in a natural state, the condition of the leaves being in all cases taken as a guide. After watering the plants in the morning they were carefully weighed and then placed in the desired position and left undisturbed till evening, or any number of hours desirable, and then were again weighed (as a rule before any more water was given). The loss of weight, as before stated, was considered equivalent to the amount evaporated during the time of the experiments.

Usually the observations were made for a day and a night, but the plants were also weighed in the evening so as to establish the relation between night and day evaporation during the same twenty-four hours. As before intimated the relationship between the dew point, temperature, etc., and the rapidity of transpiration was noted in most of the observations made. This was arrived at by means of the ordinary wet bulb thermometer, taking the average temperature and dew point according to the well known rule, which it would be needless to detail here.

With this brief yet, it is hoped, sufficiently comprehensible description of methods pursued, we shall pass to the notice of results obtained by these researches.

Plant No. 1 employed, was a common Calla (*Calla Æthiopica*), an herbaceous plant 3 feet 1½ inches high. Its whole weight on taking it up, with roots cleaned, was 2 pounds 2 ounces; weight of evaporating portion, or all above ground, 1 pound 3 ounces, 240 grains in a green state; complete weight of outfit, including plant, vessel, and apparatus adjusted for experimentation, 21 pounds 4 ounces 20 grains. This latter weight is here stated in order to avoid an unnecessary record of figures in the table of results to follow, by giving the weight of the growing plant at each time it was taken. Suffice it to give the loss of weight, or its equivalent the amount of water evaporated during the periods of time indicated. The same plan will be pursued hereafter.

The following are the results with this plant:

Ex.	Duration of Experiment.	Loss of weight or amount evaporated.	Place.	Weather.
I	12 hours, day.	1420 gr.	Indoors.	Clear.
II	12 "	195 "	"	Cloudy, rain.
III	12 "	1440 "	"	Clear and warm.
IV	12 "	2040 "	In open air.	Partly cloudy.
V	12 "	2380 "	"	Clear,
VI	12 "	3320 "	"	Clear, windy.

The important part played by the sun's rays and atmospheric currents in transpiration is very well shown by these results. The plant while indoors received the sun's rays only about half the time during a clear day, which was the case in all indoor experiments made, and, although the room in which it was kept was well ventilated, the currents were in no way comparable to the circulation of the atmosphere outside. It was found, very curiously, that this plant evaporated nothing during a cloudy night in or out of doors, and only about 460 grains on an average during clear nights in open air.

Plant No. 2 was one of our common geraniums (*Pelargonium cucullata*); also herbaceous; 18 inches high; weight in a green state, with roots washed, 9 ounces 120 grains; of green or exhaling part 7 ounces; complete weight fitted for experimentation, 9 pounds 15 ounces 350 grains. The evaporating surface of the two first plants tried was not estimated on account of the shape of the leaves, and the extent of the branches in the case of the geranium and of the leaf stalks in the case of the calla (which it would have been necessary to include) rendering it too difficult for the observer. It might be well to state here that the plants

were taken up *after* the experiments made upon them, in order to ascertain their weight.

The geranium gave the following results:

Ex.	Duration of experiment.	Loss by evaporation.	Loss by day, 12 hours.	Place.	Weather.
I	Day and night.	1560 gr.	1080 gr.	Indoors.	Clear.
II	"	1930 "	1440 "	"	Clear, warm.
III	——	——	1286 "	"	Clear.
IV	Day and night.	3380 "	2880 "	In open air.	Clear.
V	"	3730 "	3220 "	"	Clear, very warm.
VI	"	3390 "	2900 "	"	Clear.

These results indicate that the amount exhaled at night is about the same in the open air as in the house, while the evaporation in day time is more than double in the former position what it is in the latter in the same length of time. It will be observed that this plant evaporated more than the weight of the portion with exhaling surface in the course of twenty-four hours. It should be remarked that this and the previous plant were in the flowering stage.

Plant No. 3, a fuchsia (*F. macrostemma*), was a shrubby plant in the flowering stage; leaf surface estimated at 450 square inches; height of plant 27 inches; weight of the portion having evaporating surface 2 ounces; of whole plant, with roots washed and in a green state, 4 ounces; complete weight of outfit ready for experiment, 9 pounds 15 ounces 360 grains.

Coincident with the remainder of the experiments, daily observations were also made on the average temperature and dew point. It should be stated that these latter observations were taken in the same medium in which the plant was situated.

This plant gave the following interesting results:

	Duration of Experiment.	Loss of weight by evapora'n	Loss by day, 12 hours.	Avera'e temper-ature.	Average dew point.	Place.	Weather.
I	Day and night	1810 gr.	1260 gr.	77.°	61.4°	Indoors.	Clear.
II	"	1800 "	1240 "	72.	51.2	"	Clear.
III	"	1450 "	980 "	68.	49.9	"	Partly cloudy.
IV	"	2270 "	1910 "	63.5	49.5	In open air	Cloudy, some rain.
V	"	2415 "	1930 "	65.9	50.5	"	Clear, partly cloudy.
VI	"	2510 "	2020 "	65.	49.9	"	Clear, windy.

It will have been observed that the average temperature was higher, and the dew point consequently correspondingly lower during the time of the observations made on this plant in the

house than when exposed to the open air; this, no doubt, accounts for the fact that more was lost at night while indoors than when exposed, as may be seen by subtracting the amounts evaporated by day, in the table, from the whole amounts given off in twenty-four hours, the *average* at night having been 540 grains per night while indoors, and only 422 grains per night outside. Temperature and the relative humidity of the atmosphere would therefore seem to influence transpiration at night, the weather, apart from the conditions mentioned, having been about the same at night in the two cases. These results also show that the process is at least twice as active when the plant is exposed during the day as when kept in the house; and yet, as before intimated, the average temperature and the complement of the dew point were higher during the experiments made indoors than when the plant was out of doors. This would go to show that sunlight and currents of air are, one or both of them, great modifiers of this process.

It is interesting to notice that this plant evaporated 100 grains more than its own weight (4 ounces) in twelve hours.

Plant No. 4, *Hydrangea arborescens*, a shrubby plant in æstivating stage, 2 feet high; weighed, in a green state with roots cleaned, 4 ounces 250 grains; leaves alone, 2 ounces 250 grains; evaporating surface of leaves, 744 square inches; complete weight of plant fitted for experimentation, 7 pounds 11 ounces 240 grains.

It was found on taking up this plant, after the experiments had been made on it, that the quantity of earth its roots had to draw moisture from was rather too small, notwithstanding this circumstance, however, the results obtained are full of interest. They are the following:

Ex.	Place of experiment.	Duration of experiment	Loss of weight by evapora'n	Loss by day, 12 hours.	Avera'e temper-ature.	Average dew point.	Weather.
I	In open air	Day and night	3010 gr.	2450 gr.	71.°	54.6°	Clear, windy.
II	"	"	2395 "	1910 "	71.	55.8	Clear, calm.
III	"	"	2425 "	1940 "	75.5	59.2	Clear.
IV	"	"	2515 "	2045 "	75.	57.5	Clear.
V	Indoors.	"	1460 "	975 "	79.	58.7	Clear.
VI	"	"	1370 "	900 "	80.	59.8	Clear.

In proportion to the extent of evaporating surface, this plant did not exhale as much as the Fuchsia; whereas the relation between the weights of the two plants, and the quantity evaporated by each respectively, is about the same. In the case of the

Fuchsia strong currents of air hastened the process, for while on the last day the Fuchsia was experimented with, the temperature was no higher and the difference between the dry bulb and dew point was not as great as on the previous day, it was found to exhale most—exceeding all the rest of the results by 92 grains. This latter excess, under the circumstances, must, in part at least, have been due to atmospheric currents, which were more prevalent on that day. The influence of these currents was still better exemplified by the results from the Hydrangea. It will have been noticed that this plant evaporated, at least an ounce more during experiment I. than on any succeeding day. The atmospheric currents no doubt produce their effect in a mechanical manner. They remove vaporized fluid as it is formed, and thus really act as a *vis a fronte* to the vaporizing liquid within.

Apart from the influence of winds, and given a clear day, a glance at the two last tables of results will show a direct correspondence between the complement of the dew point and the rate of transpiration in these cases. This latter fact will become more evident hereafter.

A few observations were made on the Hydrangea with the view of determining the rate of evaporation of different periods during the day. It was found that this plant while in the open air evaporated between the hours of 11 A. M. and 3 P. M. as much as in the remaining eight hours of the day's experiment.

Plant No. 5 was a *Camellia japonica*, a shrubby plant 28 inches high; leaf surface 479 square inches; complete weight of outfit ready for experiment, 8 pounds 12 ounces 40 grains.

The following results were obtained:

Ex.	Duration of experiment.	Loss of weight by evapora'n	Loss by day, 12 hours.	Av'ge temper-ature.	Av'ge dew point.	Place of experiment.	Weather.
I	Day and night	710 gr.	710 gr.	78.5°	63.3°	In open air	Clear. [rain.
II	"	650 "	650 "	79.5	71.3	"	Cloudy part, some
III	"	170 "	480 "	70.	61.5	"	Cloudy, clear at night
IV	"		240 "	74.	63.	Indoors.	Cloudy. [part.
V	"	10 "	190 "	74.	65.7	"	Cloudy and rainy in
VI	"	250 "	250 "	74.5	65.8	"	Clear.

These results exhibit in a satisfactory manner the connection between the character of the leaf structure and the rapidity of evaporation. The fact that this plant had leaves of dense structure and with thick cortical coverings must account for the very much smaller quantity of evaporation; and yet some allowance

ought to be made in this case for the less favorable meterological conditions during the time this plant was used, as shown by the table.

Again, it is very probable that in plants with evergreen leaves having thick epidermal tissue evaporation is only possible through the stomata, whereas in the case of leaves which are thin, soft and rapidly growing, with little cortical tissue, evaporation is more general from their surfaces. It is quite possible, also, that the number of stomata in the case of the Camellia is below the average. However these things may be, the fact remains, that the nature of the cuticular tissue of the leaves is hereby shown to be closely related to the amount of liquid transpired.

This plant exposed during a cloudy and dewy night gained in weight to the extent of 310 gr., as shown by the table; the same thing occurred on a rainy night in the house, when the plant was situated about four feet from an open window, as was the case in all indoor experiments; the gain in the latter case, as shown by the table, being 230 gr. There was no loss by evaporation at night in the open air.

Plant No. 6, was a Lantana (*L. carnosa*), a shrubby plant, 18 inches high; leaf surface 330 square inches; weight only 1½ ounces; complete weight fitted for experimentation, 5 pounds 2 ounces 250 grains.

The following are the results:

Ex.	Duration of Experiment.	Loss by Evaporation.	Loss by day, 12 hours.	Av'ge temperature.	Av'ge dew point	Place.	Weather.
I	Day nd night	1360 gr.	1200 gr.	66.°	52.2°	In open air	Clear, cloudy.
II	"	988 "	688 "	64.	54.4	"	Cloudy during day.
III	"	1820 "	1820 "	76.	63.3	"	Cl'r, windy dewy n't.
IV	"	2120 "	1920 "	79.5	65.6	"	Clear, windy day.
V	.....	.....	1930 "	79.	66.	"	Clear, windy.

The leaves of this little plant were very thin and soft, which may account, in a measure at least, for the great rapidity of transpiration from their surfaces. As compared to the extent of leaf surface, this plant evaporated more than any other plants tried, reaching, in a clear windy day, nearly 2 ounces per square foot of leaf surface in twelve hours. It will be observed that the Lantana evaporated nearly three times its own weight in twelve hours.

A few experiments were made with this plant (as was done with the Hydrangea) to ascertain how much more rapid the process was about midday than at other periods of the day. It was found

to be most rapid about noon and a little after; and it was found here, also, that half the quantity evaporated by day was given off between the hours of 11 A. M. and 3 P. M. These observations were made on clear days.

The last, or plant No. 7, was a Dracæna, an herbaceous plant with large leaves (being cultivated for its foliage). Its leaf surface was estimated at 817 square inches; its height 27 inches; weight not taken; complete weight of outfit, 11 pounds 6 ounces.

The following are the results obtained:

Ex.	Duration of experiment.	Loss of weight by evaporatn	Loss by day, 12 hours.	Aver'ge temper-ature.	Average dew point.	Place.	Weather.
I	Day and night	2784 gr.	2410 gr.	66°	52.2°	In open air	Clear.
II	"	1870 "	1385 "	64.	54.4	"	Cloudy, clear at night.
III	"	2601 "	2351 "	76.	63.3	"	Clear, during night.
IV	"	2670 "	2410 "	79.5	66.6	"	Clear, windy day, do.
V	"	2770 "	2520 "	79.	66.	"	Clear, much wind.

In comparison to the extent of leaf surface, this plant did not transpire as fast as most of the other plants used. The fact of the Dracæna having smooth and more or less hard leaves, no doubt accounts for the relatively less rapid evaporation from its surface. In the case of the two last plants tried, it may have been noticed, as in the two before them, that, other things being equal, dryness of the atmosphere was favorable to the process of transpiration.

In experiments IV and V, with both the Lantana and Dracæna, are shown once more the favorable influence of winds over this process in plants. The scales used in all these experiments were accurately adjusted.

Summary of Investigations.

In clear weather the evaporation by night as compared to that which takes place in the day appears to be about in the ratio of 1 to 5. In some cases no loss occurred on dewy or cloudy nights. The Camellia, however, lost nothing during clear nights, and gained in weight on dewy or rainy nights, even when kept indoors. Under ordinary circumstances evaporation at night was about the same indoors as in the open air.

The rate of transpiration during the day showed a very different relation, giving a ratio of 2 to 1 in favor of the open air. Of the whole amount evaporated during twelve hours, in the day experiments, half was given off between the hours of 11 A. M. and 3 P. M., as shown by repeated testing.

. The following table, compiled for the number of clear days, will serve to exhibit the average rate of transpiration by day which took place in the open air during clear weather. It will also indicate the relation between leaf surface and the weight of the plant, and amount transpired.

The mean temperature and average dew point have also been recorded in the table.

No.	Name of Plant.	Duration of experiments	Average evaporati'n	Evaporating surface.	Weight of plant.	Average temp'ture.	Average dew point.
1	Calla.....	12 hours.	2850 gr.	All parts green	2 lb. 2 oz.	.....	.....
2	Geranium....	"	3500 "	.....	4420 gr.	.....	.....
3	Fuchsia	"	1975 "	450 sq. in.	1920 "	64.5°	49.6°
4	Hydrangea ..	"	2858 "	744 "	2170 "	73.	56.7
5	Camellia	"	710 "	479 "	.....	75.5	63.3
6	Lantana.	"	1717½ "	330 "	720 "	75.1	61.7
7	Dracæna	"	2422 "	817 "	.....	75.5	62.

After an inspection of this table, the average rate of evaporation for soft, thin-leaved plants, in clear weather, may be put down at about 1¼ ounces per day (12 hours) for every square foot of leaf surface. The Lantana shows nearly 2 ounces to the square foot of surface. The Camellia, with its dense, smooth leaves, averaged less than half an ounce to the square foot of surface, per day.

The nature of the leaf structure modifies very greatly the rate of evaporation, as may be seen by comparing the results from the Camellia with those of other plants having soft and thin leaves.

Apart from structural peculiarities, no doubt the sun's rays stand first in importance among the modifying influences; for going back to the results from the Fuchsia, for instance, we find the average temperature higher and the dew point greater during the indoor experiments than when the plant was exposed, and yet the relation of evaporation in the two situations was, other things being equal, about as ordinarily the case. The same obtained in the case of the Hydrangea in a still more marked degree.

It is still an unsettled question whether radiation, as such, produces this great effect, or whether it is through the heat that accompanies the rays, or the chemical changes they produce.

That the difference between indoor and out of door evaporation was not due so much to atmospheric currents as to the action of the sun's rays, is shown by the fact that, during the ex-

periments outside on a cloudy day, strong atmospheric currents did not by any means raise the daily quantity to what it was on a calm but clear day. But it must be remembered that currents are much more effectual in hastening the process in clear than in cloudy weather, for the simple reason that the sun's rays opening the pores of the plant, allow of the more ready escape of aqueous vapor.

Of the influence of currents, then, it might be stated, from what has been observed, that in clear weather they are very effectual in favoring the process; in cloudy weather their influence is not so noticeable. On clear days strong currents increased the amount over that of calm days by about one-fifth or even one-fourth.

It was found, in every instance tried, that, other things being considered, the complement of the dew point, or the dryness of the air, modified in a marked degree the rate of transpiration; and this appeared to be, in a measure at least, independent of the temperature, as the latter condition did not seem to affect perceptibly the amount evaporated, unless, as is usually the case, the relative humidity was correspondingly low.

A few calculations may serve to impress the importance of the ratio of transpiration, deduced from these experiments. According to the above rate the Washington Elm, at Cambridge, a tree, it is stated, of no very large size, with its 200,000 square feet of leaf surface, would transpire 7¾ tons of watery vapor in twelve hours (day) of clear weather.

Carrying the calculation further, a grove consisting of five hundred trees, each with a leaf surface equal to that of the elm mentioned, would return to the atmosphere 3906 tons of aqueous vapor in twelve hours. Even supposing this to be much overestimated, it may very fairly be concluded from the facts given that the evaporation of watery vapor from plants is a powerful agent in maintaining the humidity of the surrounding air. And if the above data be correct, a strong argument is furnished in support of the belief that vegetation influences, in a great degree, the rainfall of a region of country.

The practical advantage of keeping plants in occupied rooms, in which the air is generally dryer than outside, has, also, from the results obtained, received further demonstration.

RAMBLES OF A BOTANIST IN NEW MEXICO.

BY EDWARD LEE GREENE.

I.

SANTA Rita del Cobre is situated in the extreme south-western part of New Mexico, amid the Santa Rita mountains, so rich in copper ore. It was in former times a Mexican penal colony where convicts did service in the mines; now, however, since the acquisition of that region by the United States, Santa Rita del Cobre has become a mere pile of adobe ruins; the crumbling walls, a group or two of neglected and very ancient looking peach trees, and the abandoned mines showing to him who passes through, that the place was not always the silent wilderness it now appears. New towns are at present springing up within a few miles, in different directions; for the American people have discovered rich silver mines not far from where the Mexicans found only the grosser and less valuable metal. It is an interesting region, the natural history of which has not been looked into except by the few scientists who have accompanied one or two government surveying expeditions in passing through it. Aglow with the ardor of a botanist in a new field of study, I entered this remote corner of New Mexico from the westward early in April. The broad expanse of plains through which runs the boundary line between this territory and Arizona was already decked with a profusion of flowers. The number of species was not great, but each species was represented by myriads of individuals, so that the whole prairie landscape seemed painted in lively colors. The plant most common of all was the smaller species of California poppy (*Eschscholtzia douglasii* Hook. & Arn.), one of the characteristic plants of the Pacific coast, hardly to have been looked for unless as a rarity so far eastward as this. In northern parts of California the Eschscholtzias sometimes grow in such abundance on the plains that sensitive eyes are dazzled and pained by the intense brightness of the mass of golden yellow bloom; yet never in California have I seen a landscape more brilliant with these flowers than were these level tracts away upon the borders of New Mexico. An albino variety, more pleasing than the normal yellow was frequently noticed, its petals not pure white but pale cream color, with a yellow spot at the base.

In fine contrast with the sun yellow of the California poppies, was the bright purple of a spreading Verbena, common here (*V. bipinnatifida* Schauer), a species which adorns the plains all along the base of the Rocky mountains from Mexico to the far northward. A blue flowered dwarf lupine (*L. brevicaulis* Wats.) was noticed in very sandy places, and two larger leguminous plants were conspicuous, not by their flowers which in both species were small, dull-purple, but by their large inflated pods. On one of them (*Astragalus diphysus* Gray) these pods were decidedly ornamental, being specked with dark purple, and looking almost like nests of birds' eggs as they lay in clusters on the sand, for the stems that bear them are nearly or quite prostrate. The other is also an Astragalus (*A. trifloris* Gray), producing almost white and very thin membranous pods of oblong shape. These when mature fall from the stem without opening to discharge their seeds, and are tossed about over the plains by every wind; sometimes lying in heaps under the lee of bushes and tufts of grass or other herbage. These harmless toys of the winds had, before I was accustomed to their ways, to my nerves, a singular little faculty of suggesting evil, the effect of which might slightly have amused a witness, had there been one. The weed gatherer on these plains needs to be always on the look-out for rattlesnakes; one of these reptiles may be lying coiled up under or near by any plant which he steps aside to examine or collect. The warning rattle is a sound he is familiar with. Now while he bends over some novel and interesting plant, absorbed in contemplating its peculiarities, or busily preparing specimens of it for his port-folio, let a passing breeze set in motion one of these bladdery capsules, and as it tumbles near with its detached seeds rattling within, ten to one he will be startled with the idea that a serpent is at his heels. The sound of the rattlesnake is very perfectly reproduced by the moving dry astragalus pod and seeds.

From these plains we pass gradually up to the highest lands of the low range, called the Burro Mountains, and are within an easy day's journey of the ruins of Santa Rita del Cobre, and equally near a number of new and lively mining camps. For a southwestern mountain chain the Burros are well watered and well timbered; that is to say, there are small springs and streamlets to be met with at intervals of a few miles, and their gentle slopes and rounded summits produce a scattered growth of oaks, pines

and cedars, all being peculiarly south-western species of rather dwarf and stunted habit. There is also a considerable variety of shrubs and herbaceous plants, making it altogether very interesting ground for the herbalist. The zest of botanizing in these hills was, however, a little tempered by fear of Indians. At the time of my journeying among them the Apaches were giving more trouble than usual, "on the rampage" as the settlers have it; sometimes riding up boldly to the lonely stage stations and driving off stock before the eyes of the solitary keeper; now and then shooting down upon the high road a helpless mail-rider for the sake of his pony, or an unprotected buck-board driver for his span of mules, and keeping all travelers and the few scattered settlers in a state of perpetual fear.

"Wagons close by?" asked the lone tenant of the one hostelry in the Burro Mountains, Carson by name, and nephew of the renowned "Kit," as port-folio in hand and haversack over my shoulder I came to his door a little before sunset. I answered that I knew of no wagons being on the road. "You come alone?" I replied in the affirmative, and volunteered at once such brief account of myself as would partly satisfy his manifest curiosity. "Well," said he, after a pause, and with an assumed air of calmest philosophy, "I reckon a man don't die 'till his time comes." The fact was the Apaches had made *him* a call only the day before, and driven away captive the horses that chanced to be grazing on the hillside opposite the door, and the man had not quite recovered from his fright. I, the luckier mortal, had leisurely botanized across a hundred miles of the infested region without having seen a savage. Nothing more formidable than Carson's pet turkey had I met with on all the road. This bird, a remarkably fine specimen of his species, assailed me furiously with beak and wings as soon as I came near the house. There are no domestic turkeys in the country, and this wild one had come to the ranch alone, of its own accord, when a mere chick, and that evidently with a mind to renounce forever the society of its kindred. Carson called the bird his dog, and assured me that he never failed by his loud cry of alarm to announce the approach of an Indian or any stranger, either by day or night. Both his antecedents and character seemed to me rather remarkable, and I record them here for the edification of the ornithological. At this stage-station I resolved to establish

myself for a day or two for the purpose of studying somewhat carefully the flora of the vicinity. In the early morning I wandered out among the picturesque rocky hills to find their sunny southward slopes covered with purple Phacelias (*P. crenulata* Torr.), scarlet Indian-pinks (*Castilleia integra* Gray) and many other plants less showy but more interesting to the botanist.

Hemispherical masses of a low-growing cactus with light scarlet flowers (*Cereus phœniceus* Engelm.) adorned the otherwise barren rocks away towards the summits, and here also in the shade of a lofty overhanging precipice, I detected, to my great delight, the handsome saxifragaceous shrub Fendlera (*F. rupicola* Eng. and Gray). It was hardly yet in flower; but a few weeks later in the more immediate vicinity of Santa Rita I saw it in perfection, its gracefully recurved branches resembling wreaths of large rose-colored, or sometimes nearly white flowers, interspersed with narrow green leaves. It is a beautiful bush, and one which from its home in the secluded mountain dells of the far south-west ought to be introduced to our gardens and made the associate of its much admired kindred, the Deutzia and the mock orange. I returned from this day's ramble bringing a port-folio well filled with rare plants, and in my hand a bundle of the thick leaf-stems of a stout-growing species of dock (*Rumex hymenosepalus* Torr.). The latter I handed to my good-natured, obliging host, with the request that he would have them made into a pie for my dinner. He looked at the stems suspiciously, at me enquiringly, and said *he* would have the pie made if I wanted to eat it and run all risks. This I agreed to. On the previous day, after having traveled from early morning until long past mid-day without water, I had pulled the root leaves of this fine-looking dock, eaten a considerable quantity of the thick, juicy and pleasantly tart petioles, and found them refreshing. I thought it worth while to try to demonstrate to these dwellers in a wilderness where there are no fruits, that in this common plant of the valleys around them they had a very tolerable substitute for rhubarb at least. Carson remarked that when the pie was taken from the oven it smelled nicely, but I could in no wise prevail on him to taste it. He was afraid the "weed" was "something poison."

As a Rumex or dock, this species is remarkable as growing not in wet places after the habit of most species of its genus, but often on dry plains, far from springs and streams, just where its

sour, juicy, refreshing stems might often be very serviceable to travelers if acquainted with its properties.

From the summit of the Burros the eastward slope stretching away for thirty miles, to the base of the Santa Ritas, descends so very gradually that the whole tract appears more like an elevated plain than like a mountain slope. The vegetation is that of the higher south-western plains, there being no trees, few bushes, in fact not much but grasses and numerous species of the vast genus Astragalus. The Astragali that grow here (*A. mollissimus* Torr.; *A. missouriensis* Nutt.; *A. humistratus* Gray; *A. cobrensis* Gray; *A. shortianus* Nutt., and *A. nuttallianus* Gray) are mostly very handsome sorts, with more or less white, silky foliage, and fine racemes of rich violet, or pink, or purple flowers, quite different from the rattle-podded things of the same genus which occupy the plains at the western base of this same range of hills.

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RECENT LITERATURE.

LeConte's Geology.[1]—The body of this work is divided into three parts, treating respectively of dynamical, structural and historical geology. The author devotes the large space of 160 pages to the consideration of the dynamical agencies concerned in producing crust-modification. Atmospheric, aqueous, igneous and organic agencies are successively considered. Erosion due to rain and rivers, the action of waves and tides, glacial action, chemical agencies, each receive a full share of attention, with good illustrations. The subject of earthquakes and volcanoes is fully and elaborately discussed and the great geyser district of the West receives more attention than has been devoted to it hitherto in any popular work. The illustrations of the great geysers, from the Reports of Hayden's Survey, give the book a freshness that will be appreciated by all American students. The section devoted to the consideration of reef-formation is full of valuable matter with well chosen illustrative diagrams, as is also that on faunal and floral distributions.

The hundred pages devoted to structural geology is an unusually large proportion for this subject, but the many varieties of faulting and unconformability due to various causes, and which are calculated to puzzle the young geologist, require the full elucidation which they receive in the work.

[1] *Elements of Geology.* A Text-book for Colleges and the General Reader. By Joseph LeConte, Professor of Geology in the University of California. 903 illustrations. 8vo, pp. xiii, 588. D. Appleton & Co., New York, 1878. Price $4.50.

To the historical part the author devotes about 300 pages, which, as he informs us in the introduction, has been considered throughout from the standpoint of the evolution hypothesis. This is a new and commendable feature in an American text-book, as previous authors have made it only a secondary matter.

The earlier floral and faunal characteristics of the American continent are illustrated by well chosen figures from the works of Dawson, Hall, Meek, Worthen, Gabb, and others. The carboniferous flora receives a large share of attention, with many figures from Dawson and Lesquereux. Some of the figures of vertebrate remains are not as good as they might have been; some, as those of *Glyptodon*, *Megatherium* and the head of *Sivatherium*, are restorations made before enough of the skeleton was known to make exact figures, which have since been superseded by more recent studies from more perfect material.

The value of this part of the work is somewhat curtailed by the use in some instances of a nomenclature which is not used by European or many American palæontologists. As examples we cite the names *Edestosaurus*, *Tylosaurus*, *Lestosaurus* and *Dinoceras*, which have never been distinguished from genera previously named, and *Brontotherium*, which there can be but little doubt is the same as the genus long since called *Titanotherium*, by Leidy, and still earlier *Menodus* by Pomel.

FOSTER'S PHYSIOLOGY.[1]—In introducing advanced students to the study of physiology, Mr. Foster starts from a description of the Amœba and its physiology, and having described the vital qualities of the protoplasm of an Amœba, he leads the reader to study the vital qualities of the higher animals, which, as taught by morphological studies, "are in reality groups of Amœbæ peculiarly associated together. All the physiological phenomena of the higher animals are similarly the results of these fundamental qualities of protoplasm peculiarly associated together. The dominant principle of this association is the physiological division of labor corresponding to the morphological differentiation of structure. Were a larger or 'higher' animal to consist simply of a colony of undifferentiated Amœbæ, one animal differing from another merely in the number of units making up the mass of its body, without any differences between the individual units, progress of function would be an impossibility. The accumulation of units would be a hindrance to welfare rather than a help. Hence, in the evolution of living beings through past times, it has come about, that in the higher animals (and plants) certain groups of the constituent amœbiform units or cells have, in company with a change in structure, been set apart for the manifestation of certain only of the fundamental properties of protoplasm, to the exclusion

[1] *A Text Book of Physiology*. By M. FOSTER, M.A., M.D., F.R.S., Prælector of Physiology and Fellow of Trinity College, Cambridge. London: Macmillan & Co., 1877, 8vo, pp. 559.

or at least to the complete subordination of the other properties." This extract from the introductory chapter strikes the keynote to the method of treatment of the subject. It is without doubt, and we have the word of a competent physiological expert for it, the most compact, clear and advanced text book of physiology in the language. The style is simple, clear and concise, and the preface is written in a happy vein with a dry humor that is unexpected but not the less telling and forcible. The book is designed chiefly for medical students, who have already mastered Huxley's Elementary Lessons in Physiology. We think the book would have been improved by the addition of more illustrations than there are; not perhaps of machinery, but giving the results of important physiological experiments. The chapters on the Fundamental Properties of Nervous Tissues, and the Brain, are particularly good.

SEMPER'S EYES OF THE VERTEBRATE TYPE ON THE BACK OF SNAILS.[1]—This work gives the results of Professor Semper's extensive and brilliant researches on the small organs of sight, or eye-specks, scattered over the back of a shelless snail (*Onchidium*) of which he has examined nineteen species, some of them living in the Philippine islands. In the author's opinion these eye-specks have almost all the elements of the vertebrate eye. These eyes are different in structure from the tentacular eyes of the Onchidium and other land snails, as the nerve arising from them are not thrown off from the cerebral ganglion, but from the visceral nerve-centre. Prof. Semper describes the arrangement, size and number of the dorsal eyes, with their structure, and gives remarks on their developmental history; a comparison of the dorsal eyes of Onchidium with those of other animals, discusses the biological considerations resulting from these facts, and in the closing remarks of a theoretical nature, discourses on the primitive origin of dorsal eyes, and on the "Monophyletic or polyphyletic advance in the formation of the simplest dorsal eyes." We can bear witness to the beauty of the microscopic sections, having glanced at some of them through the kindness of Professor Semper during his visit in the United States last autumn. The plates are colored lithographs, and are effectively and skillfully drawn.

ZIRKEL'S MICROSCOPICAL PETROGRAPHY.[2]—This subject has in the hands of Zirkel, Boricky and others in Germany and Austria, attained a good degree of development, but little attention

[1] *Reisen im Archipel der Philippinen*, von Dr. C. SEMPER. Zweiter Theil. Wissenschaftliche Resultate. Drittu Band. Land-Mollusken. Ueber Seh organe vom Typus der Wirbel thier augen auf dem Rücken von Schnecken. Von Dr. C. Semper. Mit fünf Tafeln Colorirter abbildungen, Wiesbaden, 1877. 4to, pp. 46.

[2] *United States Geological Exploration of the Fortieth Parallel.* Clarence King, Geologist-in-Charge. Microscopical Petrography. By FERDINAND ZIRKEL. Illustrated by twelve plates. Washington, 1876. 4to, pp.

having been bestowed upon it in England, except in a slight way, we believe, by Forbes and Sorby; in this country it has suffered almost complete neglect, though undoubtedly a few will by this volume be stimulated to special research in a department promising interesting results. The present volume will therefore form the starting point, a basis of comparison for future American micro-geologists. Mr. King and his assistants, Messrs. S. F. Emmons and Arnold Hague, made large collections of crystalline rocks along the Fortieth Parallel in the western United States. Professor Zirkel was invited to New York to make a preliminary examination of the collection, thus becoming acquainted with the geological distribution, relative age and reciprocal connections of the rocks, so that their minute chemical and mineralogical constitution has been made from a geological view, greatly enhancing the value of Zirkel's labors. At home the author carefully studied more than twenty-five hundred thin sections of these rocks, crystalline or of volcanic origin, and he pays Mr. King the compliment that "your original designations should almost never be altered or corrected." The plates are excellent and well colored.

BULLETIN OF THE BUFFALO SOCIETY OF NATURAL SCIENCE.—Amongst the valuable papers contributed to volume III. 1877, we notice more especially those by Grote and Pitt on the Crustacea of the Water-Lime Group of Buffalo; On Texan Lepidoptera, by L. F. Harvey; also papers on Lepidoptera by Grote and Scudder, and a list of North American *Syrphidæ* by C. R. Osten Sacken. There are two papers on the Hyphomycetous and Discomycetous Fungi of the United States; an article concerning the Fishes of the Ichthyologia Ohioensis, and a Check List of the Fishes of the Fresh Waters of North America. The last paper is the joint production of Prof. Jordan and H. E. Copeland, and is a valuable contribution to our ichthyological literature, bringing together material which has heretofore been scattered through a great variety of documents. Archæological papers by Dellenbaugh, Howland and Grote are also worthy of notice. The Bulletin presents a make-up and typographical accuracy worthy of all imitation. We observe that the positions of Director of the Museum and Chairman of the Publication Committee are still filled by Mr. A. R. Grote.

BULLETIN OF THE UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.[1]—This last number of the Bulletin is of varied interest, reflecting the breadth of view that characterizes the administration of the survey, and the efficiency of its editor, Dr. Coues. There are articles on *Mammalia* and birds, among which we notice one on the ornithology of the lower Rio Grande valley, by Mr. Sennett, who enumerates several species, which Dr. Coues determines to be new to our political limits. A

[1] Vol. IV. No. 1. F. V. Hayden, Geologist-in-Charge.

very important paper by Mr. Ridgway characterizes the families of the *Herodiones*, and the subdivisions and genera, chiefly of the *Ardeidæ*. The precision of definition exhibited in this paper gives it a first rank in scientific work of its kind, offering an example worthy of imitation in all departments. We observe, however, that the learned author thinks it necessary to employ generic names for groups characterized by size and color, and forms of feathers which are sometimes only seasonal, and sometimes very slightly differentiated, a custom which is not adopted by students of other classes of *Vertebrata*. Dr. Coues furnishes interesting accounts of the consolidated hoofs of certain individuals of *Cariacus virginianus* and *Sus scropha*. His conclusion regarding the latter is stated in the following rather too highly figurative language: "The upshot of this modification of the foot is, that a strictly artiodactyle animal is transformed into an imperfectly perissodactyle one. As far as the hoof is concerned the pig is completely solidungulate." There are entomological articles by Messrs. Scudder, Grote and Chambers, and two palæontological ones by Prof. Cope. One of the latter is a reply to Prof. Owen's criticism of Prof. Cope's writings on the Pythonomorphous reptiles. An article by Drs. Coues and Yarrow gives useful information regarding the geographical distribution of Batrachia and reptiles of Dakota and Montana. But we cannot see why the authors should again describe the dentition of the genus *Crotalus*, and the well-known characters of the teeth of *Heterodon*, which may be found in any of the general herpetological works. The distribution of the *Eutænia proxima* is erroneously given as extending over the entire United States west of the eastern region. Its range is N. E. Mexico, Texas and part of the Mississippi Valley.

RECENT BOOKS AND PAMPHLETS.—Die Cœlenteraten, Echinodermen und Würmer, der K. K. Osterreichisch-Ungarischen Nordpol Expedition. Von Dr. Emil v. Marenzeller. Wien 1877. 4to, pp. 42.

Darwin; or God in Nature. By Robert McK. Ormsby. Second Edition. New York. Masonic Publishing and Furnishing Co. 1878. 12mo, pp. 69.

Brehm's Thierleben. Band iii, Heft 9–14 vii. 1–2. Leipzig, 1878. New York: B. Westermann & Co. 8vo. 40 cents a Heft.

Twelfth Annual Report of the Commissioners on Inland Fisheries for the year ending January 1, 1878. Boston. 1878. 8vo, pp. 64.

Proceedings of the Boston Society of Natural History. Vol. xix. Part II. Boston. 1877. 8vo, pp. 111.

Notes on the Mineralogy and Petrography of Boston and vicinity. By M. Edward Wadsworth. (From the Proceedings of the Boston Society of Natural History xix.) 8vo, pp.21.

Fifth and Sixth Annual Reports of the Curators of the Museum of Wesleyan University. Including a History of the Museum from its Formation. Middletown, Con. 1877. 8vo, pp. 26.

A List of the Species of the Tribe Aphidini, family Aphidæ, found in the United States, which have been heretofore named, with descriptions of some new species. By Cyrus Thomas. (From Bulletin No. 2, Ill. State Lab. of Nat. Hist.) 8vo, pp. 14.

Report on the Geological and Geographical Survey of the Rocky Mountain Region. By J. W. Powell. Washington, D. C. 1877. 8vo, pp. 19.

GENERAL NOTES.

BOTANY.

DAVENPORT'S NOTES ON BOTRYCHIUM SIMPLEX.[1]—In 1821, the late President Hitchcock collected at Conway, Mass., specimens of a fern which he at first referred to *Botrychium lunaria* Sw. Two years later, however, he published in Silliman's Journal, a description of the species, giving to it the name of *Botrychium simplex*. That the species has had an uncertain place in pteridography, is evident from Mr. Davenport's account of its drifting in different editions of one work from *B. virginianum*, Sw., to *B. lanceolatum*, Angs., to *B. matricariæfolium*, A. Br. Part of this confusion is suspected by Mr. Davenport to have arisen from the fact that President Hitchcock really collected two distinct species, namely, *B. matricariæfolium* and *B. simplex*. This supposition is rendered the more probable from the occurrence of the two species in the vicinity of the original station.

In clearing up the matter, the author has appeared to avail himself most patiently of every means of discrimination in his power. A critical examination of all the specimens known to him to have been hitherto collected for *B. simplex*, is followed by an analysis of a portion of Milde's monograph of the genus Botrychium, and by diagnosis of *B. simplex* and *B. matricariæfolium*. Mr. Davenport's studies were carried on without a knowledge of Milde's paper, and his conclusions independently reached are the same as those held at one time by Milde. These may be stated as follows, in a translation of Milde's words:

"The characteristics of *B. simplex* lie:—

"1st. In the stalked sterile frond approximate to the rhizoma.

"2d. In the unsymmetrical segments of incomplete half-lunate forms.

"3d. In the kind and manner of the evolution of the forms."

Mr. Emerton's figures given in this work exemplify the above characters very fully. To this may be added the peculiarities of the spores. *B. simplex* has large spores closely covered with small points, never with warts.

B. matricariæfolium has spores which are thickly covered with large warts.

Mr. Davenport states in his prefatory note that "if the publication of these notes shall prove to be of any service to fern-students, they will owe it entirely to the generosity of Mr. Robinson." We have only to add to our notice the single remark that the typographical execution and the plates are of superior excellence, to indicate to our readers the indebtedness of fern students to both Mr. Davenport and Mr. Robinson.—*G. L. G.*

MOVEMENT OF AN AQUATIC SUBMERGED PLANT.—M. Rodier has recently made some interesting observations on the rhythmical movements of a well-known water-plant, *Ceratophyllum demersum*.

[1] *Notes on Botrychium simplex* Hitchcock. By GEORGE E. DAVENPORT, 1877. (22 quarto pages, with two plates, privately printed.)

The branches of this plant present two different aspects. Sometimes the whorls are very close to each other, the internodes being very short, and the leaves of the consecutive whorls resting on each other, make with the stem a very acute angle and form a compact mass. In other cases the internodes are elongated, the whorls more distant and the leaves become more and more nearly at right angles to the stem, until at length some of them actually point downwards. It is this last form which displays in the most striking manner the movements here described. Taking the axis at the moment when it is nearly erect, it is seen to bend regularly, curving more and more for about six hours, when it reaches its maximum of flexion; then straightening itself more slowly, it resumes its original position in about twelve hours. It next bends in a direction opposite to its first flexion, and in four hours it attains its maximum of inverse flexion, resuming its first position again in four hours. The total duration of an evolution is hence about 26 hours. Thus a young branch is vertical at 6 A. M., attains its maximum of flexion at noon, is again perfectly erect at midnight, attains its maximum inverse flexion at 4 A. M., and is again vertical at 8 A. M., etc. If examined carefully under favorable conditions it is seen that the movement of flexion takes place first in the higher or younger internodes, advancing thence with diminished intensity from above downwards; while, on the contrary, the movement of erection commences with the lower or older and ends with the upper internodes. The oscillations continue very apparent during several days, diminishing usually at the end of a certain time. Light does not appear to have any influence on the movements, which were carried on with as much vigor when the light was partially or entirely cut off, when it was thrown by means of a mirror from the opposite direction, or when it was made to pass through red glass. M. Rodier was unable to detect that the leaves have any motion of their own, independent of that of the stem.—*A. W. Bennett.*

THE EUCALYPTUS IN CALIFORNIA.—Last season the Central Pacific Railroad Co. planted 300,000 gum trees on the lines of their roads. This winter they intend to set out 700,000 more. Those set out by the Company around their shops in Sacramento last season having made such rapid and healthy growth, the Company are now planting 2,000 additional trees, placing them in every available nook and corner around the works and along the track by the slough.

GERMINATION OF ACORNS.—In this place (Lansing, Michigan) white oak acorns germinate in autumn. The radical pushes out and down into the leaves or soil often for three inches or more. The petioles of the cotyledons grow out from the shell about half an inch. This enables the plumule to find plenty of room to start in spring. It is quite common to find two embryos in one acorn, and three embryos are not very rare.—*W. J. Beal.*

ABSORPTION OF WATER BY ROOTS.—Vesque gives the following results of his experiments:

1st. The absorption of water by roots is not proportionate to the temperature of the leaves when the latter are surrounded by an atmosphere not saturated with moisture. At low temperatures it increases only slightly as the temperature rises; but at a certain degree fixed for each plant absorption increases rapidly, and at a maximum temperature becomes stationary; this maximum varies in different species.

2d. The absorption of water by roots is independent of the temperature of the leaves when these are surrounded by a saturated atmosphere, in the dark, and protected from calorific radiation.

3d. Calorific radiation in the dark acts in a very energetic manner upon transpiration in saturated air, and produces upon absorption the same effect as an elevation of temperature does upon leaves which are in dry air.—*From Annales des Sciences Naturelles, September*, 1877.

ZOÖLOGY.[1]

HOMOLOGIES OF THE EAR-BONES OF MAMMALS, ETC.—Professor G. Baraldi, in the *Atti della Societa Toscana di Scienze Naturali*, of Pisa, for 1877, has a paper on the homologies of the organs accessory to respiration in fishes, and the organs of hearing in the higher vertebrates, with special reference to the homologies of the branchiostegal and opercular bones of fishes, the tympanic bones and cartilages of the ear-conch of mammalia. A plate and tabular synopsis which accompany the paper show that he regards the hyomandibular of fishes, the columella of amphibia, reptiles and birds as homologues of the stapes of mammals; and the symplectic of fishes, suspensory cartilage of amphibia, ossicle of the tensor tympanica of reptiles and birds as homologues of the orbiculon or lenticulon of mammals. The bone homologous with the incus of mammals, are the quadrate (Gegenbaur), tympanic (Owen) of reptiles and birds; the quadrate or suspensorium of amphibia, the quadrate, hypotympanic, jugal, hypocotyleal, os quadrato-jugal as it has been variously called, of fishes. The articulare of fishes, amphibians, reptiles and birds are homologues of the mammalian malleus. The branchiostegal rays of fishes, the cartilaginous tympanic ring of amphibians, without homologue in reptiles and birds, is homologous with the tympanic ring of mammals. The interoperculum of fishes (no homologues in amphibians, reptiles and birds) is homologous with the annular or tubiform cartilage of mammals. The opercular of fishes, homologues wanting in amphibians, reptiles and birds, is regarded as homologous with the cartilaginous ear-conch of mammals. The sub-operculum of fishes (homologues absent in amphibians, reptiles

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

and birds) are regarded as the homologue of the scutiform cartilage in mammals.

It will be noticed upon comparison with Huxley (*Anatomy of Vertebrates*) that while the latter author divides the otic bones in mammals between the hyoidean and mandibular arches, Professor Baraldi puts the malleus (articular), the incus (quadrate), the orbiculare and stapes (columella), all in the mandibular arch. The differences between the two authorities on the homologies of these parts in other forms consists mainly in this, that Baraldi puts the stapes, columella and orbiculare into the mandibular arch in all the forms, while Huxley relegates them to the hyoidean. The studies are all from actual subjects.

TERRESTRIAL MOLLUSCA OF TEXAS.—During a recent visit to Texas the writer had an opportunity of making quite an extensive collection of the land shells, and a still more interesting collection of the *Reptilia* and *Batrachia*. The land shells exhibited a few peculiar characters which would be of interest if fully discussed. The species discovered were as follows:

1. *H. thyroides* Say; two varieties, one of which has the umbilicus closed. This variety was the only one occurring at Orange and Beaumont, on the Texas and New Orleans Railroad, one hundred miles east of Huston. At Huston only the typical species was found. Mr. Bland, who has kindly examined these shells, suggests that the non-umbilicate variety is the *H. bucculenta* Gould.

2. *Zonites friabilis* W. G. Binney. Typical; rare, under bushes at Orange.

3. *Helix monodon* Racket; a small, elevated variety, under logs in pine woods.

5. *Bulimulus alternatus* Say. Common under bushes in prairies.

6. *Helix mooreanus* W. G. Binney; "considered a variety of *H. tholus*." (Bland.)

7. *Helicina tropica* Jan.

8. *H. berlandieriana* Moricand. This shell occurred in great abundance in the grass, on a sandy bluff of the bayou at Huston, associated with the *H. triodontoides* Bland, and *H. thyroides* Say. In this situation the shells were almost totally without cover, a circumstance somewhat anomalous.

9. *H. texasiana* Moric.; abundant under logs, bark, stones, etc.

10. *H. espiloca* Ravenel; abundant at Orange, and also at Brashear City, La., under bits of bark, boards, small sticks, etc.; even in the door-yards of private residences. Associated with it was *Helix pulchella* Müll., and *Pupa pentodon* Say, at Brashear City.

11. *Helix vultuosa* Gould, "typical," (Bland). With this was found, at a place twenty miles north of Beaumont, in Hardin

County, a very curious variety, which differs, materially, and for which I propose the name of *H. copei*, or *H. vultuosa* variety *copei*, and of which the following is a description:

Shell reddish, somewhat thin, deeply striated by lines of growth, and of medium size. Spire somewhat depressed in some specimens, slightly more elevated in others. Whorls five, transversely striated with oblique lines of growth, and increasing very gradually and regularly in size; a faint carina appearing at the junction of the upper third and lower two-thirds of the body-whorl, from which the latter tapers inwardly to the base of the shell. Sutures regularly and moderately impressed. Peristome sub-acute, and broadly reflected outward and downward at its lower two-thirds, and bearing on its basal third an acute carina, within which is seen a prominent, vertical, double tooth, of which the outer portion is the larger. A second tooth is carried by the inner margin of the peristome at the centre of the body-whorl, the point of which is in close relation to an arcuate tooth carried by the parietal wall of the aperture. Umbilicus wide, exhibiting most of the volutions. Height 7 mm. Lesser diameter 12 mm. Greater diameter 14 mm. This size is about the average.

This shell differs from the *H. vultuosa* Gould, to which it is closely allied, and of which it is perhaps but a very distinct variety, in the following particulars: It is a larger shell but of lighter texture. The lines of growth are more deeply impressed, though this character might not be constant in a larger number of specimens. The lip is much more broadly reflected below, with a sharper central angle, and much more produced outwardly, at the point of junction of the upper third with the lower two-thirds. The umbilicus is much wider, exhibiting the volutions more plainly. The arrangement of the teeth is very distinct in the two species or varieties under consideration. This shell I collected under logs in pine woods, twenty miles north of Beaumont, in Hardin County, Texas, where it was associated with the *H. bucculenta* Gould, *Zonites intertextus* Binney, *H. monodon* Racket, *Helicina tropica* Jan., *Zonites demissus* Binney, and *Zonites arboreus* Say. I dedicate the shell, with great pleasure, to my friend, Prof. E. D. Cope.

The specimens of *Z. intertextus* and *Z. demissus* were very large, and some of the latter exhibit the peculiarity of bearing an indistinct carina.—*W. G. Weatherby.*

A Strange Flight of Hawks.—A very curious phenomenon occurred in this neighborhood during the last week in September. A number of trustworthy persons who witnessed the sight all give the same facts. Near Middle river, about sixteen miles south of Fulton, thousands of large hawks were seen circling just

above the trees. After they reached the creek near A. T. Williams' farm, large numbers of them lit in the trees and collected close together. Parties with shot-guns went in among them and killed a number, but the hawks seemed tired and determined to rest, and the firing failed to put any considerable number of them to flight. Those that did fly soon settled down again. After resting about three hours they rose again, forming great circles often interlacing each other, and pursued their flight toward the south. The specimens killed and examined show that they were not quite so large as hen-hawks, and they were not prairie-hawks. R. W. Maid, who witnessed this extraordinary sight at a point some eight miles distant, says they were "quail-hawks," and that as the quails begun to leave the country, they were in pursuit. Many of the hunters who were out looking for birds tell us that they saw hundreds of quail in the immediate neighborhood of the hawks, but they refused to fly, and ran, as if in terror, to the thickest parts of the brush. That there were an immense number of hawks is shown by the fact that no one could see them all at once, though they were flying very high; and by the fact that they were seen at about the same hour by persons eight and ten miles apart.—*California paper.*—*Communicated by R. E. C. Stearns.*

A Texan Cliff Frog.—G. W. Marnock has recently discovered in south-western Texas a new species of the genus *Lithodytes*, which Prof. Cope calls *L. latrans*. It lives in fissures in the limestone cliffs that stretch across that section of the state. According to Mr. Marnock the eggs hatch out in the winter, and the tadpoles live in the rainwater which is caught in the shallow holes in the rocks, far from the creeks. During the winter the adults are very noisy, the rocks resounding in the evening with their dog-like bark. The noise is supposed by the country people to be made by lizards, especially the *Gerrhonotus infernalis* which occurs in the same region. *Lithodytes* Cope, embraces many other species, from Mexico and South America. It is referred to the *Cystignathidæ*.

Occurrence of the Phylopod Eubranchipus in winter.—Specimens of adult male and female *Eubranchipus vernalis* Verrill, were brought, on January 10th, into the Museum of the Peabody Academy of Science, from Danvers, Mass., by Mr. John H. Cook. Mr. John Sears, an observing man, who saw these specimens, assures me that he has found similar ones in Danvers in early winter (December) when the ice is forming. It has also been observed by Mr. J. S. Kingsley and myself at Salem, Mass., April 12th, and there is now no reasonable doubt but that this species attains it maturity in the autumn from eggs dropped by the females in the spring, and it is probable that most of the species of this family attain their development late in the summer and early in the autumn.—*A. S. Packard, Jr.*

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—Mr. F. W. Putnam, in the *Nation*, for January 3d, reviews Mr. Prime's work on pottery with reference to the north-west coast of America. Sabin's *Bibliotheca Americana*, which most of our readers know to be the standard authority upon books relating to America, has reached its fiftieth number with the word Jamaica.

Dr. Georg Fischer, of Freiburg, contributes to *Archiv für Anthropologie, &c.*, 1877, III, an able paper upon mineralogy as an auxiliary to archæology. Some months ago this distinguished author published a work upon the same subject, at the same time calling upon those who are interested in the matter to send him fragments of jade implements, or their shavings removed from the unsculptured side with a diamond saw. The article above alluded to gives especial attention to Mexican jades.

Dr. Gustav Brühl continues his brochures entitled "Die Culturvölker alt-Amerikas," Part V–VII, relates to monuments and antiquities in Colombia, Peru, and the valleys of the Colorado and Rio Grande; Part VIII to writing; and Part IX to chronology. Issued from New York, Cincinnati and St. Louis.

From January 15th to March 1st, in the halls of the Louvre set apart for the exhibition of antiquities, the anthropological specimens collected in South America, by explorers sent out by the French government, will be displayed. On the eighth of January, Mr. C. C. Jones, of New York, made a communication to the Lond. Anth. Inst. upon American bird-mounds. Mr. Wm. Owens contributes to *Lippincott's Magazine* for January an article on the Folk-lore of the Southern negroes.

ABROAD.—The dying out of the Polynesian races, Sir David Wedderburn in *Fortnightly* (*Popular Science Monthly*, Supplement, III); The Races of the Danube, John Fiske in *Atlantic Monthly*, April; Beiträge zur physischen Anthropologie der Deutschen, Virchow in Abhandlungen der Konigl. Academie zu Berlin; the first six parts of the Mittheilungen der Anth. Gesellschaft in Wien, contain very able articles upon Contemporaneity of Men with the Cave-bear in Mähren, On the use of stone weapons indicated by certain expressions in the German language, On Terramares in Hungary, A new domestic dog of the bronze period, Trepanation, Perforation of Stone implements, The Archæological Commission of St. Petersburg, &c.; Man and the Glacial Period, Thomas Belt, *Popular Science Monthly*, Nov.; Land und Leute im Seegebiete Australiens, *Aus allen Welttheilen*, Nov., 1877; On the Malays and Polynesians, Rev. S. J. Whitmee before the Anthropological Institute, Nov. 27th; Discussion upon the evidence as to the Antiquity of Man in Great Britain, in Journal of the Anthropological Institute for Nov. (an exceedingly

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

valuable number); Les Kourganes de la province de Saint Petersburg, and Sculptures préhistoriques situeés sur les bords des lacs des Merveilles, *Matériaux* viii; Chronometres fournis par la géologie pour mesurer l'antiquité de l'homme; Congres Archéologique de France, and Sur le Traitement des Morts chez les Peuples aryens primitifs, *Matériaux* ix.

Prof. Edward S. Morse has found traces of pre-historic man in Japan. Near a station on the railroad to Tokio, called Omori, are shell-heaps composed of shells of various genera, such as Fusus, Eburnea, Turbo, Pyrula, Arca, Pecten, Cardium and Ostrea. The heap examined is 200 feet wide, and from 1 to 6 feet deep. Over this is a deposit of earth three feet thick. Fragments of bone, implements of horn and pottery were found. While the mass resembled similar structures found in New England by Prof. Morse, the prevailing characteristics were the immense quantity of pottery and the absence of bone implements and of flint flakes. On account of the distance from and elevation above the shore, the absence of stone implements, and the great thickness of the beds above, the Professor supposes the deposit to be of great antiquity.—*O. T. Mason, Washington, D. C.*

GEOLOGY AND PALÆONTOLOGY.

The Geological Survey of New Zealand is pursuing its labors with much success under the able management of its director, Dr. Jas. Hector. This gentleman gives the thickness of the strata from the Carboniferous to the Lias as over 18,000 feet. The beds have south dips, are full of joints, and exhibit two great stratigraphical breaks. They present seventeen fossiliferous horizons. A remarkable feature of the palæontology is the low range of *Belemnites* and the high range of long-winged *Spirifers*. Some huge saurians occur at one of the horizons.

A new genus of Dinosauria from Colorado.—A form of this order has recently been discovered in the Dakota Beds of Colorado by Mr. Lucas, which is quite different from those already announced. The vertebræ resemble those of typical *Dinosauria* in their solidity and slightly amphicœlous extremities, and in the wide discoidal form of the proximal caudals, but differ from them in the extraordinary elevation of the dorsal zygapophyses, which stand on a stem composed of the neurapophyses. The anterior zygapophyses of the dorsal vertebræ are united on the middle line, forming a basin which receives the posterior zygapophyses. This is not the case in the anterior caudals, where the zygapophyses have their usual position, and the summit of the neural spine is expanded transversely. This genus has been named by Prof. Cope, *Hypsirophus*, and the species *H. discurus*. The dorsal vertebra of the latter measures m. .105 to the base of the neural arch, and m. .300 to the middle of the

faces of the posterior zygapophyses. The centrum is m. .105 wide. The caudal centrum is m. .175 wide; and m. .160 high. The neural arch and spine are m. .575 high, and the latter m. .040 wide at the base, and m. .130 wide at the summit. The species was as large as *Hadrosaurus foulkii*. It is not impossible that it may be the same as the *Lælaps trihedrodon* Cope. The femur of this species recently discovered has very nearly the characters of that of the *Megalosaurus bucklandii*, and is quite different from that of *Lælaps*; hence, if not a *Hypsirophus*, the *L. trihedrodon* must be referred to *Megalosaurus*.

A NEW DEER FROM INDIANA.—John Collett, of the Geological Survey of Indiana, discovered in a late lacustrine deposit in Vandenburg Co., Indiana, a number of post-pliocene fossils. One of these is the ulno-radius, etc., of a *Bos*, and another is the left mandibular ramus of a deer, probably of the genus *Cariacus*. The jaw differs in its proportions from those of *C. virginianus*, *C. macrotus* and *C. columbianus*, with a considerable number of which I have compared it. It belonged to an animal of the average size of the *C. virginianus*, but differs in having the diastema an inch or more longer, while the tooth line is shorter. Placing the first molars in line, the last molar of the fossil form attains only the penultimate column of that of the *C. virginianus*; in some cases just a little further. On the other hand, the angle of the mandible extends beyond that of the *C. virginianus*, and the slope of the anterior base of the coronoid process is more gradual. At the same time this portion is less oblique in the transverse direction, owing to the prominence of the external face of the ramus. This ramus differs also in the great prominence and anterior position of the posterior edge of the masseteric fossa, which leaves behind it a wide oblique face, little developed in the existing species. The species being clearly new, I call it *Cariacus dolichopsis*.—*E. D. Cope.*

GEOGRAPHY AND TRAVELS.

THE BRITISH POLAR EXPEDITION. EXTRACT FROM SIR J. D. HOOKER'S ADDRESS AS PRESIDENT OF THE ROYAL SOCIETY—The President then passed on to a review of the scientific results of the Polar expedition, which he said in his judgment, especially the biological results, appeared to have quite come up to our expectations. Considering that but one season was available for collecting and observing (and we all know how short that is in the Arctic regions), the results are indeed most creditable to the gentlemen who contributed them. Geology has proved by far the most prolific field of research. Perhaps botany comes next. The researches in this department, and on the insects which have been worked up by Mr. M'Lachlan, prove that between 80 degrees and 83 degrees north, in Grinnell's land, the conditions for the

existence of these organisms are far more favorable than are those of lands a long way to the southward. The flora of the series of channels between 80 degrees and 83 degrees north, the shores of which have been botanized by the officers of the Polar expedition, have yielded upwards of 70 flowering plants and ferns, which is a much greater number than has been obtained from a similar area among the Polar islands to the south-westward, and is unexpectedly large. All are from a much higher latitude than has elsewhere been explored botanically, except the islets off the extreme north of Spitzbergen. The species are, with two single exceptions, all Greenlandic. Spitzbergen, altogether to the south of these positions, contains under 100 flowering plants and ferns, though its west coast is washed by the Gulf Stream, and its shores have been diligently explored by many trained collectors. Its north coast has yielded fewer plants, and no less than 15 of the plants collected by the Expedition have not been found anywhere in Spitzbergen. Contrasted with Melville island, in latitude 75 degrees north, and Port Kennedy, in 72 degrees north, the contrast is even more striking, these well-hunted spots, both so much further south, yielding only 67 and 52 species respectively. This extension of the Greenland flora to so very high a latitude can only be accounted for by the influence of warm currents of air, or of the air being warmed by oceanic currents during some period of the summer; and we look with great interest to the meteorological observations made during the voyage, which are being discussed by Sir George Nares, who hopes to have it completed in a couple of months. The observations on the temperature of sea-water will, he expects, give new information; and great interest is attached to the study of certain warm gales and warm currents that were experienced in latitude 82 degrees and 83 degrees north. May not these phenomena of vegetation and temperature indicate the existence of large tracts of land clothed with vegetation in the interior of Greenland, far within the mountain ranges of its ice-clad coast, and protected by these from the heavier snow-falls, and hence for the accumulation of glacial ice that surrounds it on all sides? Professor Heer, of Zurich, has examined the fossil plants, the most important of which are those he states to be of miocene age. There are 25 identifiable species, of which all but one have been found also in Spitzbergen. This tracing the miocene flora so far to the northward was one of the principal scientific objects to be accomplished by the Polar expedition; and the fact that its character continues to be neither Polar nor Arctic, but temperate, supports the hypothesis that during the era in question a vegetation analogous to that now inhabiting the temperate latitudes entirely capped the North Polar area of the globe. Mr. Etheridge has worked at the very valuable collection of paleozoic fossils procured by Captain Fielden, and these, with the miocene and post pliocene fossils,

have thrown more light on the former conditions of the circumpolar regions than perhaps all those of previous expeditions.

Sir G. Nares has supplied to the President the following *résumé* of some of the principal meteorological results, and their comparison with those taken at Polaris bay in 1871-2:

	Mean Annual pressure. Degrees.	Mean annual temperature. Degrees.	Minimum temperature. Degrees.
Alert, Floeberg beach.....	29.869	—3.467	—73.75
Discovery, Discovery bay.....	29.887	—3.932	—70.8
Polaris bay.....	29.970	+4.196	—45.5

Minimum temperature of earth 20 inches beneath surface—13.0 degrees.

The warmer temperature at Floeburg beach was due to its exposure to the warm winter gales from which Discovery bay was cut off. The still warmer temperature of Polaris bay is partly attributable to there being some uncovered water in the neighborhood. The tidal observations have been entrusted to the Rev. Dr. Haughton, who hopes to present his results before the end of this session of the society. He has already arrived at the following general conclusions: 1, the tide which comes down Smith's sound from the north is generically distinct from the Behring's straits tide and from the Baffin's bay tide; 2, it must, therefore, be the East Greenland Atlantic tide, and consequently Greenland is an island; 3, this new tide contains a sensible tertiodiurnal component of much interest. The result of temperature examination was thus stated: Making due allowance for unavoidable sources of error, the temperatures of the sea observed on the west shores of Smith's sound prove the existence of a stratum of cold outer water (temperature about 29 degrees) lying between the locally heated surface-water and a depth of 20 to 30 fathoms, flowing southward in summer; as also of a warm underlying stratum of about 30 degrees. This latter was not found near Floeberg beach, but coupled with the 1872 observations of the Polaris, which showed a temperature of 32.8 degrees at 203 fathoms, in latitude 80 degrees 44 minutes north (midway between Franklin and Hall's islands, in Robison channel), and 32.1 degrees at 17 fathoms in Polaris bay, it would appear that the warm underlying water forces itself to the northward on the east side of Robison channel. Its entrance into the Polar sea or not will depend on the depth of water at the north end of the channel. They also prove the non-existence of a lower temperature of the water than 28.8 degrees at above a depth of 275 fathoms in Smith's sound or Baffin's bay. The coldest portion of the Arctic water appears not to affect that near Hayes sound or Discovery bay to so great an extent as that of the direct channel.—*London Times.*

Geographical News.—The *Bulletin de la Société de Geographie* for November contains commentaries on some old maps of New

Guinea, forming materials for a history of the discovery of this country by Spanish navigators from 1528 to 1606, with a map. M. Marche has returned from the west coast of Africa after exploring Upper Ogooné. M. Wiener has finished his explorations of the Andes. Mr. N. B. Wyse, member of the International Society of the Interoceanic Canal by the Isthmus of Darien, is now making a new exploration in this region.

Prof. Mohn, in Petermann's *Mittheilungen* for January, gives an original map of the relief of the sea-bed between the British Isles, Norway, Spitzbergen and Greenland. On this the contour lines of equal depths for each 100 fathoms are shown, and the grand feature of this region, the submarine barrier which passes from the north of the British Isles across by the Faröe islands and Iceland to Greenland, rises for the first time distinctly to view. It is this great barrier, says the *Academy*, that mainly determines the conditions of the deep seas on each side of it. The depth of the Atlantic on the south-western side are filled up with warmer water, but as soon as the barrier is crossed this is limited to the uppermost strata. On the Atlantic side of the ridge a mass of ice-cold water occupies the sea in its greatest depths, and is prevented by the barrier from penetrating into the depths of the Atlantic. Prof. Mohn also proposes that the sea between Norway and the Faröe islands, from Mayen and Spitzbergen, which has never been distinguished by any special name, be called the "Norwegian sea."

Gerhard Rohlfs is to undertake a new journey of exploration in the Eastern Sahara, which is planed to extend over five years.

MICROSCOPY.[1]

Bulloch's Microscopes. — Mr. W. H. Bulloch, 126 Clark street, Chicago, has issued a well illustrated description of his recent improvements in the construction of the microscope, in which appear several points of novelty and importance. The new large stand is literally full of ingenious contrivances, and without being clumsy or unduly complicated seems to combine more really useful adjustments than any other stand containing the modern improvements.

The sub-stage and mirror bar both swing around an axis in the plane of the object on the stage. Mr. Bulloch claims, with much reason, to have been the first to apply such an adjustment to the sub-stage, and he now mounts the mirror bar in a similar manner, the two being made to move either together or separately, and either by hand or with a mechanical motion; or the sub-stage with its milled heads can be entirely removed. Thus is attained a facility not hitherto equaled of using either sub-stage or mirror or both together at any angle below the stage

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

or in any desirable position above it. The obliquity of illumination is indicated by graduated arcs. The sub-stage itself has centreing and rotating as well as vertical movement.

The fine adjustment has been removed to the same position as in Zentmayer's recent stands; but instead of a separate slide, the levers act upon the body by means of the rack itself, by moving steadily, up and down, the box in which the pinion of the coarse adjustment acts. This is forced upwards by a direct action, and downwards by a spiral spring. Great steadiness is attained, as well as the ordinary advantages of removing fine adjustment from the nose-piece. The nose-piece, however, is movable vertically, and has a safety spring as in the usual form of fine adjustment.

The stage is mounted on such a level that when the tube is placed vertically the axis around which the instrument rotates at the base will pass through the object on the stage, and consequently through the focal plane of the objective and of the illuminating apparatus, giving great advantage for optical experiments. The stage itself is sufficiently thin to admit an obliquity of illumination of 67 degrees without special appliances. It has graduated horizontal and vertical movements by means of a screw and a chain moved by milled heads upon the same axis; also a mechanical and graduated rotation around a centre which is easily adjustable to the axis of even a high power objective. It is also supplied with Brown's iris diaphragm. The iris diaphragm is furnished with the society screw so that it can be, if desired, either used in combination with an achromatic condenser, or used as an adapter above the objective itself so as to reduce directly the angle of light in the instrument.

Besides this superb instrument, Mr. Bulloch makes a smaller stand specially suited for diatom work, but well calculated for general use. It is nearly equal to the large stand in completeness and in everything but size, and has a stage (rotating but not mechanical) sufficiently thin to admit light at an obliquity of 73 degrees, and reversible so that the slide can be used on the under side with light at any desired angle up to 90 degrees. He also introduces several styles of small and low priced microscopes in which some of the most excellent and popular English and American stands are reproduced with ingenious additions and improvements.

These instruments are beautiful in form and of excellent workmanship, and they add another notable item to the recent valuable contributions of American workers in this department of science.

MICROSCOPICAL SUPPLIES.—Mr. Chas. Petit, of 151 High street, Stoke Newington, London, England, is sending cover glasses and other small supplies to this country promptly and at a low price. One ounce of thin circles are sent postpaid, for $1.25, or if thinner glass for $1.50. Two ounces of squares and circles mixed are

sent for $2, ground edged slips for $2 per gross, ornamental paper covers five hundred for $1, tin cells of any usual size and thickness for from 50 cents to $1 per gross, and glass cells at from $1 per gross upwards. One dozen and a half really good unmounted objects are furnished for $1.

MICROSCOPICAL SOIRÉE.—The Soirée given at the Agricultural and Geological Rooms, under the able direction of Professor Cox, in Indianapolis, on the 30th of January, was largely attended by the most cultivated citizens of the place. Microscopes by Zentmayer, Bulloch, Beck, Hartnack, Grunow and others were in use, and the exhibition was made instructive as well as entertaining. The opening address was made by Professor Cox, and the objects were shown and explained by the various microscopists of the city.

NEW YORK MICROSCOPICAL SOCIETY.—This new society completed its organization by the adoption of a constitution on the 21st of December last. It will meet on the first and third Friday evenings of each month. The officers for the present year are as follows: J. D. Hyatt, president; G. I. Whitehead, vice-president; A. J. Swan, 176 William street, corresponding secretary; R. Hitchcock, recording secretary; W. C. Hubbard, treasurer; D. B. Scott, librarian and acting curator.

NATURE CLUB OF ALBANY.—At the annual election, January 14th, 1878, the following officers were elected: Dr. George T. Stevens, president; Dr. Willis G. Tucker, vice-president; Richard Prescott, secretary.

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SCIENTIFIC NEWS.

— The occurrence of the hundredth anniversary of the death of Linnæus, on the 10th of January last, gave occasion to all the scientific societies and institutions in Sweden, and to several others abroad, to arrange festive meetings in celebration of the day. The Swedish papers of the succeeding days were full of descriptions of these feasts, and we give our readers a short account of one of them, which was held at the old University of Upsala, the venerable *Alma Mater* of Swedish science for more than 400 years.

At eight o'clock in the morning the bells of the cathedral proclaimed in solemn strokes that the University was going to celebrate the memorial of her greatest son. At half-past eleven the bell-ringing sounded again, calling out the members of consistorium academicum, invited guests, "the supporters and friends of science," and the 1500 students of the University, to proceed from the University to the grand hall of the College, which for this

occasion was profusely and tastefully decorated all around with fresh flowers and shields bearing inscriptions alluding to events in Linnæus's life. In the background was seen Linnæus's bust, mounted on a pedestal and crowned with a wreath of fresh laurel; it was surrounded with living Thuyas. Above this was seen Linnæus's coat of arms—in the centre a blue field with an egg (to illustrate his thesis "*Omne vivum ex ovo*"), and around this three fields, viz: one black, one green, and one red, representing the three kingdoms of nature, the mineral, the vegetal and the animal. These fields were surmounted by a helmet, out of which two cactus leaves protruded. A garland of *Linnæa borealis* was twisted round the whole crest. Opposite the background was seen, on the organ gallery, a ribbon with his motto, "*Innocue vivito, Numen adest.*" A considerable number of ladies in gala dresses added to the festive appearance of the hall. The chancellor of the University, Count H. Hamilton, the Archbishop, the Governor of Upland, the rector Manificus, and the prorector of the University had their seats next to the tribune. Next to them appeared some descendants of Linnæus, among them Dr. Tycho Tullberg, the zoölogist. The whole auditorium numbered about 1000.

The programme began with a cantata by Prof. Josephson, with words by Prof. Fr. Holmgren, of which elegantly printed copies were distributed among the auditors. Botanicus Professor Th. M. Fries then mounted the tribune and read the oration, in which he, with his usual eloquence and spirit, gave a sketch of Linnæus's immortal works as naturalist, physician and academical teacher, as well as of his private life. He pointed out how Linnæus's great genius was so much ahead of his time that many of the greatest questions of our days were already conceived by him, although not understood by his contemporaries and therefore forgotten, until in our days they have been taken up again. Even the theory of evolution was the object of his meditations, as has been proved in a newly recovered manuscript on this subject, where he called the monkeys "the cousins of man."

Humbolt has been called the originator of the geography of plants; to Goethe has been attributed the origin of the theory of metamorphoses in plants; but both were preceded by Linnæus, who in some of his works treated both those branches of botany. As mineralogist he proved to be far ahead of his time through his crystallographic discoveries. As physician he distinguished himself not only as a successful practitioner, but also as the author of many important medical papers e. gr. "Genera morborum," "Materia medica." He proved the value of applying electricity in certain cures. He pointed out the influence of certain microscopic organisms on the human body, etc. His genius and energy enabled him to complete an enormous amount of work. Only his private correspondence would have been enough

for a man of less enormous capacity, and still nearly every letter of his is a scientific treatise of great value. It is well known how he once was cured from podagra by the arrival of Kalm's large collections from North America. To him the natural history was a "gaia scienzia," and it was at the same time a form of devotion to the Creator, free from all selfishness. He regarded himself as pontifex in the temple of Nature. "I have," so he says in his preface to Systema Naturæ, "I have seen the eternal, infinite, omniscient, omnipotent God. I have seen Him and been dumb with astonishment."

In the Royal Academy of Science in Stockholm, was gathered the same evening, an illustrious assembly of all that the Swedish capital has eminent in science. This Academy was founded by Linnæus and his friends. The festival oration was read by General Wede, the Præses of the Academy. King OSCAR read a telegraphic greeting in Latin from the German Academy of Science in Frankford on Main, and also his answer in the same language. Before the meeting was dissolved, the academy decreed an appropriation to a great-grand-daughter and a great-great-grand-daughter of Linnæus, both living in rather indigent circumstances.

To the great number of busts, medals and portraits of Linnæus, previously existing, have on this occasion been added a well executed copy of the portrait of Linnæus, at the age of 67, painted by Roslin, and a new medal by Mrs. Lea Ahlborn. The large statue of Linnæus for which contributions have been collected all over the country, on the invitation of the Academy of Science, had not yet been completed.—*F. Lindahl.*

— It is proposed to issue by subscription a catalogue of scientific serial publications in all languages, which has been prepared by Mr. Samuel H. Scudder, librarian of the American Academy of Arts and Sciences, and formerly librarian of the Boston Society of Natural History.

This work, which has double the extent of any existing list of the like kind, aims to include all transactions of societies and independent journals in every branch of natural, mathematical and physical science, excepting only the applied sciences—medicine, agriculture, technology, etc. The different institutions or periodicals are arranged under the towns in which they are established or published, and the towns follow an alphabetical order under their respective countries. Cross references are given wherever desirable. It will be printed in octavo, will extend to almost 300 pages, and will be delivered, bound in cloth, to subscribers at four dollars the copy. Other copies will be printed on one side of the leaf, to be cut up for catalogue use, and will be delivered in folded sheets at five dollars the copy.

Intending subscribers may address Justin Winsor, librarian of Harvard College, Cambridge, Mass.

— A third session of the Summer School of Biology of the Peabody Academy of Science, Salem, Mass., will open July 5th, and continue six weeks. Those desiring information regarding the course of instruction, etc., may apply to A. S. Packard, Jr., Director of the Peabody Academy of Science, Salem, Mass.

— An important work has just been issued by Hayden's U. S. Geological Survey of the Territories, entitled Contributions to the Fossil Flora of the Western Territories. Part II. By Leo Lesquereux, Washington, 1878. It forms Volume VII, of the quarto reports of Professor Hayden's Survey, and is a bulky volume of 366 pages and 65 plates. It is divided into three parts, of which the first treats of the Areal Distribution, the Stratigraphy of the Lignitic Formation, and its capacity for combustible mineral, and third, the age of the Lignitic, indicated by its Geological Distribution and its Fauna. The second Part contains the Descriptions of the Tertiary Fossil Plants, while the third comprises the following subjects: The Age of the Lignitic Formations determined by the characters of the Fossil Plants; a Table of the Distribution of Species, and a Table of the Distribution of the species of the Point of Rocks.

— Two distinguished entomologists have just been removed by death: T. Vernon Wallaston, born March 9, 1821, died in England suddenly, January 4th ult. He will be remembered for his elaborate work entitled *Insecta Maderensia*, and his little work On the Variations of Species, published in 1856.

Andrew Murray, born February 19, 1812, died in London, January 10th, 1878. His quarto volume on the geographical distribution of mammals, his monograph of the beetles of the *Sphaeridiidæ*, and of the genera Cercyon and Catops, and his papers on the geographical distribution of beetles, are monuments to his memory.

Henry Lawson, M.D., died at Cork, October 4th. He was for many years the editor of the *Popular Science Review*, and conducted the *Monthly Microscopical Journal* from its commencement till his death, which has caused its discontinuance.

L. Pfeiffer died at Cassel, aged 72. His Nomenclator Botanicus was the most useful of his laborious compilations.

— One of the most important contributions to our knowledge of the marine fauna of the subarctic regions, is the famous Fauna Littoralis Norvegiæ, the second part of which appeared in 1856. The third part has lately been received in this country. It is a folio volume with sixteen plates, published at Bergen, in 1877, from an appropriation of 4000 crowns made by the National Assembly of Norway. The contents comprise the following chapters: New and little known Cœlenterates; New Echinoderms, by the late Michael Sars. The remaining chapters are by Professor

Koren and Dr. Danielssen, on the following subjects: Description of some new Norwegian Cœlenterates, Contributions to the Natural History of the Pennatulidæ living on the Norwegian coast; Description of new Bryozoa; Contributions to the Natural History of the Norwegian Gephyreæ. A new species of the genus Penella. Some of the plates are colored, and many anatomical details are given, making this part worthy of its distinguished predecessors.

— Dr. Peterman, of Gotha, in his "Geographical Notes" for November, calls Henry M. Stanley "the Bismarck of African exploration." As Bismarck united the various German principalities into one great empire, so Stanley, taking all previous African discoveries, scattered as they were and mixed up with conjectures, "with one masterly stroke united all these *disjecta membra*, wove the odds and ends of previous researches and efforts for thousands of years into one compact, valuable web." Thus he thinks that Stanley's work is unparalleled in the whole history of discovery in the world; and he proceeds to sustain the opinion by showing how Stanley transcended all that was previously known respecting the Congo river. This is lofty praise, but it comes from one whose competency to give it has never been questioned.

— Dr. Jared P. Kirtland, who died at East Rockport, Ohio, was a native of Wallingford, Ct., and was well known in this country for his attainments in natural history, and especially discoveries in conchology and ichthyology. In 1848 he was given charge of the natural history department in the survey of Ohio, and his works on the subject were published in Boston and elsewhere in the East. Important degrees were bestowed upon him by various Eastern and Western colleges, and honors were given by several societies for valuable scientific services. He was 84 years old at the time of his death.

— A letter just received from Prof. J. Schoetter, Secretary General of the "Congrès International des Américanistes," states that one volume of the proceedings of the interesting and successful meeting, held at Luxembourg on the 10–13 of September, 1877, would be issued about the first week of December. The second about the last of February, 1878. The next session will be held at Brussels in 1879, instead of in this country, as was at one time proposed.—*E. A. Barber.*

— The American Museum of Natural History in Manhattan Square, at Seventy-seventh street and Eighth avenue, was opened to the public December 22d, by President Hayes. It is a high, red brick building, with modified English-Gothic windows.

An eloquent address was delivered by President Elliott, of Harvard College, in which he is reported to have said:

"We are assembled here to view with gratitude the beneficent

power of natural science, to praise and thank its votaries, and to dedicate this splendid structure to its service. The power to which we do homage is the accumulated intelligence of our race applied, generation after generation, to the study of nature, and this palace is the storehouse of the elaborated materials which that intelligence has garnered, ordered and illuminated. What has natural science done for mankind that it should be thus honored? Natural science has engendered a peculiar kind of human mind. The searching, open, humble mind, which, knowing that it cannot attain unto all truth, or even to much new truth, is yet patiently and enthusiastically devoted to the pursuit of such little new truth as is within its grasp, having no other end than to learn, prizing, above all things, accuracy, thoroughness and candor in research, proud and happy, not in its own strength, but in the might of that host of students whose past conquests make up the wondrous sum of present knowledge, whose sure future triumphs each humblest worker in imagination shares. It has been reserved for natural science in this generation to demonstrate the universality of hereditary transmission and its controlling influence upon the families, nations and races of men, as well as upon all lower orders of animate beings. It is fitting that natural history should have given this demonstration to the world, for the basis of systematic natural history is the idea of species, and the idea of species is itself founded upon the sureness of hereditary transmission upon the ultimate fact that individual characteristics are hereditable. As the knowledge of heredity recently acquired by science permeates society it will profoundly affect social customs, public legislation and governmental action. It will throw additional safeguards around the domestic relations, enhance the natural interest in vigorous family stocks, guide wisely the charitable action of the community, give a rational basis for penal legislation, and promote both the occasional production of illustrious men and the gradual improvement of the masses of mankind. These moral benefits will surely flow from our generation's study of heredity. Modern science has exalted the idea of God, the greatest service which can be rendered to humanity." After Prof. Marsh, President of the American Association for the Advancement of Science, had delivered a brief address, President Hayes was introduced by President Stuart. The President said: "Mr. President, Ladies and Gentlemen—Without introduction I now perform the honorable but brief and simple duty assigned to me at the opening of this enterprise, so noble, so valuable and so splendid, which the country owes to the enlightened liberty of the city and the citizens of New York. And I now declare that the opening ceremonies have been completed; that the American Museum of Natural History is now open."

The building has been built by the city of New York, while the fine collections in it have been purchased by private subscrip-

tions. Each hall is 170 feet long by 60 wide, inside the walls. The lowest story is 18 feet high; the second, or principal story, including the gallery is 30 feet; the upper story 22 feet, and the Mansard story 16 feet in height.

— On the 21st of May, 1877, fourteen carp, only three of which were old enough to spawn this season, were placed in a pond near the residence of Henry Parsons, three miles from this city. On the 10th of October, following, the pond was drawn off, and the original fourteen carp, much grown and in a fine condition and healthy, together with their increase of 1408 young and vigorous fish, were taken out and placed in a breeding pond for next year.

— A Sea Lion and Sturgeon in Combat. In San Francisco bay the angler sometimes hooks a salmon that has had a piece bitten out of the shoulder by the rapacious seal, and certainly the seal lives by masticating fish in whole or part. Recently the passengers on the 10 o'clock, A. M. boat from Oakland, witnessed a tough fight between a sturgeon and a sea lion. The seal bit viciously at the gill openings of its adversary, and showed superior finesse in planning the campaign, while the sturgeon lashed the water powerfully with its unequally lobed tail, and occasionally administered a stunning blow to the seal. Blood flowed profusely and the water was dyed for yards around, but eventually the sturgeon yielded up the ghost, being seized unluckily by the tail and paralyzed in movement by having its only propeller nearly bitten off. Thus wounded and circumvented, it speedily desisted from the battle, and the seal administered the *coup de grace*, and towed his dinner beneath the waves. The spectacle was an exciting one.—*San Francisco Paper.*

— A new species of Chimæra has recently been captured on the Banks. This is the first occasion of this interesting fish so low down the American coast, though a species occurs in British waters.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

California Academy of Sciences, December 17th.—Dr. H. Behr read an interesting paper giving the results of his experiments on the resistance of some species of Eucalyptus to ignition. Whether all the Eucalypti share in this peculiar power of resisting fire, has not been ascertained. His observations had been chiefly directed to the *Eucalyptus rostrata* in Australia, where he had often seen it flourishing in burnt tracts where every other tree had been consumed. He attributed this peculiar property of the

wood chiefly to its physiological structure and chemical composition rather than to its vitality.

A general discussion on the Eucalypti followed, in which several members stated that some species of that tree had been found impervious to the attacks of frost as well as heat.

The concluding paper of the evening—on the "Necessity of a Physical Survey of California"—was read by Prof. Davidson. He believed that such a survey was of the utmost importance to the State, and enumerated the advantages that would be equally gained by the farmers, manufacturers and capitalists, from a perfect map illustrating accurately the physical, geographical and geological features of every part of the State. Such a map, he believed, would be of the greatest service for the reclamation of swamp lands, to understand the hydraulics of the Sacramento Valley, to open new avenues of travel and transportation, and to afford valuable information for all the industries. Another important reason why the State should undertake such a work was the fact that the whole system of maps and land surveys adopted by the United States Government is a delusion, and any one who has examined this subject will find them to be full of the most glaring errors and inaccuracies. At another meeting, Dr. A. Kellogg described a new species of "hog peanut" vine named by him *Amphicarpea arizonica;* and a paper by President John Le Conte, of the University of California, on "Mars and his Moons," was read by Mr. S. B. Christy. Mr. Hollister presented to the Academy a specimen of Japanese persimmon, grown in Mr. Hollister's orchard at Santa Barbara. In Japan, it is said, as many varieties are grown as of the apple here, and the sweetness of the fruit is always retained.

He remarked, "The fruit is, I think, the most beautiful of all the fruits I have ever seen, and is the most delicious to the taste. I carried four of them to San Francisco last fall, which weighed three-quarters of a pound each. The fruit is a rich yellow color, and seems more like a ball of wax than a fruit. It is simply splendid. I think it will be the greatest acquisition to our State ever introduced.

"This variety, known as the *Diospyros kaki*, differs materially from the wild persimmon of the Southern States, as it ripens without frost, and is equally palatable whether fresh or dried. The tree is highly ornamental, a prolific bearer, and as hardy as the pear. Its season is from October to March, coming in when fine fruits are scarce. The fruit is of a bright yellow, orange or reddish color, and is pronounced equal to the pear or peach. It is also sufficiently solid to be packed and shipped with safety. It grows to a large size, attaining in some cases a pound each in weight.

"The Japanese persimmon is perfectly adapted to the soil and climate of this country, and may be cultivated precisely as the

apple. The grafted trees bear in about four years, seedlings require double that time and are not reliable."

American Geographical Society.—January 31st. The members received the Earl of Dufferin, Governor-General of Canada, and then considered Capt. H. W. Howgate's plan for the exploration of the Arctic regions. Addresses were delivered by Capt. Howgate, Mr. W. C. Bryant, Mr. Bayard Taylor, Hon. I. I. Hayes and Chief-Justice Daly, President of the Society.

Appalachian Mountain Club.—February 13th. Papers were read on the Mt. Desert Hills, by Rev. J. C. Adams, and on Roan Mountain, North Carolina, by Prof. J. H. Huntington.

Boston Society of Natural History.—January 16th. Mr. G. W. Bond made a communication on the Origin of the Merino race of sheep.

American Academy of Arts and Sciences.—February 13th. Prof. B. G. Wilder read a paper on the ærial respiration of Amia.

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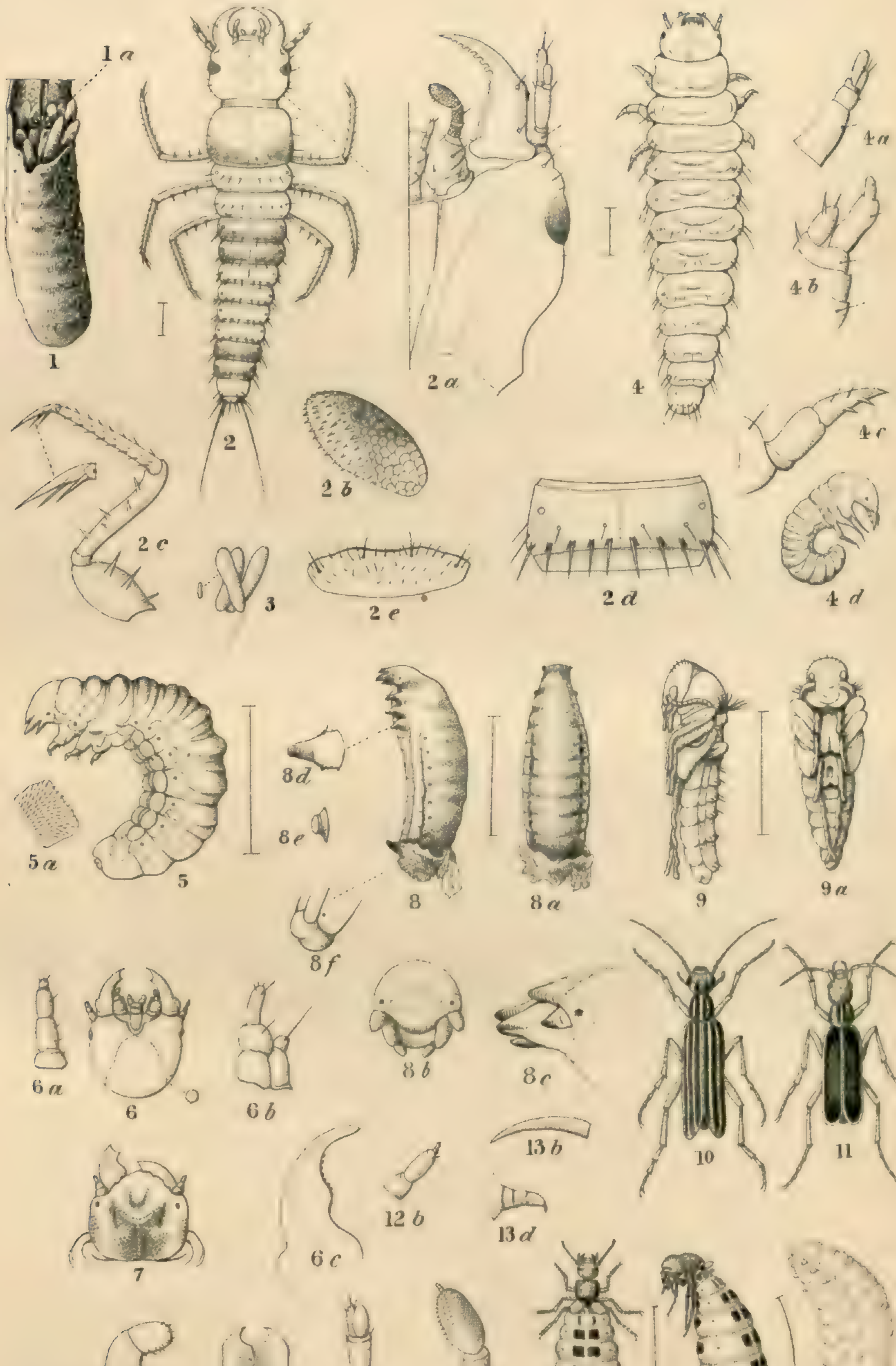
SCIENTIFIC SERIALS.[1]

The Geographical Magazine.—January. Language-map of the East Indies, by R. Cust. The north-western frontier of India. The still unexplored parts of South America, by C. R. Markham. The ancient silk-traders' route across central Asia. Affairs in Japan, by R. H. Brunton.

American Journal of Science.—February. Echinoid fauna of Brazil, by R. Rathbun. Poplars of North America, by S. Watson.

Annales des Sciences Naturelles.—December 31, 1877. Mémoire sur l'Embryologie des Némertes, par J. Barrois. Expériences sur le Developpement rubanaire du Cysticergne l'homme, par M. Redon.

[1] The articles quoted here are, in some cases, selected.



C.V. Riley, del

A. Gast & Co. St. Louis, Lith.

Hypermetamorphoses of Epicauta and Hornia.

EXPLANATION OF PLATE I.

All the figures enlarged unless otherwise stated, the hair-lines indicating the natural sizes.

FIG. 1.—Egg-pod of *Caloptenus differentialis* with the mouth torn open, exposing the newly-hatched larva of *Epicauta vittata* (1 *a*) eating into an egg, and the passage which it made through the mucous covering—natural size.

FIG. 2.—Dorsal view of the first larva, or triungulin, of *E. vittata;* 2 *a*, one side of the head of same from beneath, greatly enlarged so as to show the mouth parts; 2 *b*, terminal joint of maxillary palpus showing imbrications and flattened inner surface armed with stout points; 2*c*, leg, showing more plainly the tarsal spines; 2 *e*, labrum; 2 *d*, one of the abdominal joints from above, showing stout points, stigmata and arrangement of spinous hairs.

FIG. 3.—Eggs of *E. vittata*, the natural size indicated at side.

FIG. 4.—Dorsal view of the Carabidoid stage of the *Second Larva* of *E. vittata;* 4 *a*, its antenna; 4*b*, its right maxilla; 4 *c*, its leg; 4 *d*, side view of same, showing its natural position within the locust-egg mass.

FIG. 5.—Lateral view of the ultimate or full-grown stage of the *Second Larva* of *E. vittata;* 5 *a*, portion of the dorsal skin, showing short setaceous hairs.

FIG. 6.—Third head, or that from the Scarabæidoid stage of the *Second Larva* of *E. vittata*, from beneath, showing the reduction of mouth-parts as compared with the first head (2 *a*); 6*a*. antenna of same; 6 *b*, maxilla of same; 6 *c*, mandibles of same.

FIG. 7.—Fourth head, or that of the full-grown larva of *E. vittata*, from above; 7 *a*, leg of same; 7 *b*, the breast-plate or prosternal corneous piece.

FIG. 8.—Lateral view of the pseudo-pupa or *Coarctate Larva* of *E. vittata*, with the partially shed skin adhering behind; 8 *a*, dorsal view of same; 8 *b* its head from the front; 8 *c*, same from side; 8 *d*, tuberculous leg; 8 *e*, raised spiracle; 8 *f*, anal part of same.

FIG. 9.—Lateral view of the true pupa of *Epicauta cinerea* Forst.; 9 *a*, ventral view of same.

FIG. 10.—*Epicauta vittata* (*lemniscata* or trivittate var.).

FIG. 11.—*Epicauta cinerea* Forst (= *marginata* Fabr.).

FIG. 12.—Antenna of the triungulin of *Epicauta pensylvanica;* 12 *a*, maxilla of same; 12 *b*, labial palpus of same.

FIG. 13.—♂ *Hornia minutipennis*, dorsal view, 13 *a*, lateral view of same; 13 *b*, simple claw of same; 13 *c*, *Coarctate Larva;* 13 *d*, leg of ultimate stage of *Second Larva*.

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THE PRAIRIE DOG, OWL AND RATTLESNAKE.

BY S. W. WILLISTON.

VERY singular and amusing stories have been, and still are, accepted by many of the amicable relationship existing between the prairie dog, burrowing owl and rattlesnake. It is not within the province of the present article to repeat them, for they are familiar to every school boy. Many of their habits, however, are yet little understood, and I shall endeavor to give the results of several years observation on the plains and in the mountains.

The prairie dog (*Cynomys ludovicianus*) is widely extended through nearly all the Rocky Mountain region of the United States, and seems to thrive equally well in the bleak regions of the Upper Yellowstone, or in the fervid tableau of Central Mexico. In the rich, fertile lands of Central Kansas, they sometimes become disagreeable nuisances to the farmers, making sad havoc among the fields of growing grain. In the dry, scorched deserts of Southern Colorado, I have seen the villages where one would almost suppose the simplest forms of animal life were incapable of being supported. In the cold, bleak Laramie plains, where but little vegetation save the sage brush can exist, and where for more than six months in the year they seldom dare expose themselves to the bitter winds, they thrive in countless numbers. They are, however, provident little fellows, and literally make hay while the sun shines! Late in the summer one will frequently meet burrows, around the entrance of which, for some distance, the grass has been neatly mown, and left to cure. Were he to visit any of them a day or two later, he would find the hay all cleanly removed. In a few instances I have surprised the inhabitants carrying the nicely preserved hay into their dwellings. As their

food consists, almost exclusively, of grass and succulent stems, I doubt not that they thus provide food, as well as bedding, for the sometimes long and rigorous winters they have to endure. But notwithstanding their prudent squirrel-like habits they emerge in the spring much less plump, with the surplus of fat acquired by autumn, well nigh exhausted.

They prefer for their villages, gently sloping lands skirting the valleys, but are often found in the tops of the highest divides, and far down near the streams, though always avoiding rocky, marshy, or even moist grounds. The villages rarely cover many hundreds of acres, and are even miles in circumference, but more usually number from a score, to a hundred or two burrows.

Whole villages will, not infrequently, be deserted, and left to the peaceful possession of the owls and snakes. The cause of such nomadic habits is not clearly seen.

It requires a considerable courage to trace out one of their burrows. They descend obliquely and sinuously to considerable depths, and frequently, if not usually, I believe, have more than one opening. The entrance is always protected by a circular mound, and after a severe rain, or when otherwise damaged, the busy little inhabitants carefully repair it, throwing the dirt up with their hind feet till water is securely guarded against. Their holes are rarely seen in situations where any but the severest freshets would overflow. But once have I known their villages to be extensively inundated, and, as in that instance, the camp was washed away, and all the members of our party given a very cold midnight bath, they were certainly excusable for lack of foresight! The instinct that teaches them of such danger is not strange, when we recollect that animals of lower intelligence, as the brown thrush and wild goose will depart from their usual habits, and build nests beyond reach of the constantly recurring freshets.

During all warm, pleasant days, the villages are scenes of busy activity. Never strolling beyond immediate reach of their retreats, they have few enemies to fear besides the snakes. They are clumsy in movement like a young pup, and, when rarely surprised at a distance from their burrows, may be caught without much difficulty. They are quite social among themselves, and when not engaged in hunting food, make frequent calls upon their neighbors, to discuss, probably, the affairs of their quiet commonwealth.

At the first approach of an intruder, a general scampering takes place throughout the village with warning cries; upon reaching their mounds they sit perfectly erect, like so many sentinels, curious to know the cause of all the commotion. Upon nearer approach they sit more closely in the entrances, and threaten most vehemently, throwing up their tails in a very comical manner with each energetic bark, their noisy chatterings mingled with liquid, gurgling tones. Not infrequently, they will allow one to approach within a rod or two, growing still more vociferous in their scoldings, and occasionally making very amusing little dashes, as if to overawe the intruder. In a twinkling they disappear and continue their gurgling remonstrances a few feet below the entrance. It is very hard to obtain specimens by shooting, for no matter how badly wounded, they elude their would be captor, instinctively—one might say, automatically, for I have seen them escape beyond reach after the rifle had spattered their brains over the mounds! A readier way to obtain them is by inverting a barrel or high box half filled with sand over an entrance. They will find their way to the surface of the sand, but cannot return, and are thus securely caged.

A dog, or other small animal dying in the burrow, is allowed to remain, and it is rare that a mound, not freshly made, will not show skeletons of one or more.

I have noticed the young most frequently in May, less so in August, or early September, in litters of from four to six or seven, playing about the entrances. They are not far behind the adult in their noisy chatter, but less timorous, remaining last on the surface, and responding to the parents' gurgling below, as if much the wiser.

The prairie dog readily becomes accustomed to the haunts of man, their villages sometimes being scattered through the outskirts of thriving towns. Though easily tamed to feed from one's hand, they resent caresses, enforcing their scoldings with ready use of their sharp incisors. In a little town in Western Kansas, a pair of tame ones after frequent changes, took up their abode in a large, open lot, where they were very noisy in their protestation against intrusion, especially of the school children and dogs. A young lady teacher in passing by, incurred their highest resentment. They would follow her closely, often to the school house door, a distance of several hundred yards, chattering noisily, and

making furious angry dashes at her, till she was compelled to choose another path. In three years they had propagated to a very considerable little colony with several dozen burrows.

I have seen it stated that the prairie dog finds an enemy in the skunk. I can hardly credit it. The skunks of the plains frequent the low marshy lands near streams and ponds, raising their young near the water's edge; and not usually approaching the vicinity of the prairie dog villages; their food consisting mostly of insects, snails, crayfish, etc. Prof. Snow observed them feeding largely upon *Amblychila cylindriformis.*

It is a prevalent belief in the west, and has so been published, that these animals dig wells for their water! I have never yet learned of an authenticated instance, and in many cases the idea is absurd. Their villages are often in high localities, several feet above water, and much of the distance through loose impervious sand or rock strata! It is true that in captivity they readily and frequently drink, but this is also the case with the little striped squirrel (*Spermophilus*), and that the latter also dig wells is too great a tax upon credulity. They do not obtain water from the surface even when within convenient distance.

The prairie dog and burrowing owl (*Speotyto* var. *hypogæa*) will, not infrequently, occupy the same hole, but the latter, like the other parasites, is there on sufferance, to whose presence the dog pays but little heed, though probably one of the causes of the abandonment of the villages. Not long since I was greatly amused while passing a mound upon which an owl was quietly engaged in contemplation, at the attempts of a squirrel to pass by into his hole. If any of my readers have ever observed a puppy attempting to purloin the treasures of a sitting hen, they will have a very good idea of the action and appearance of both owl and dog—the owl very indignant and the dog very sheepish. After numerous ignominious retreats, however, he finally ran the gauntlet successfully, but not without several most vicious peckings.

There are but few birds that present a more ridiculous appearance than these owls. Most of the time during the day they spend standing quietly at the entrance of their dwellings, engaged, apparently in the deepest contemplation. At the appearance of an intruder they begin the most comical bowings and courtesies, all the while staring with their solemn eyes till with a cry not

unlike a watchman's rattle, nor less melodious, they fly to a neighboring mound and resume their pensive meditation. At nightfall they fly about in search of food, and through many months have I listened to their monotonous tones blending with the similar notes of the raincrow and the startling cry of the cayote, upon the stillness of the western plains. By far the most frequently, the owl is found in the deserted villages of the prairie dogs, in communities by themselves. The young or half grown I have only noticed in the latter part of July and August.

The relations of the rattlesnake with both squirrel and owl, although not at all friendly, is scarcely so inimical as one might suppose. Of the species most peculiar to the prairie dog regions (*Crotalus confluentus*), I have destroyed many hundreds, and although in numerous instances the stomach would show the young of the prairie dog, yet I was never positive in finding the young owl. In one instance I found the adult dog poisoned by the rattlesnake, and twice have caught the half grown as they were driven out by the venomed blow. In these instances the cry of pain and fear was almost incessant, and peculiar; the little victims succumbed in three or four minutes to the fatal poison. For a long time I believed that the occupancy of a burrow by a snake would prevent the ingress of the dog, but I am now satisfied that such is not the case. The rattlesnake is never wanton, it simply defends itself from danger or annoyance, or procures its food by means of its terrible fangs. Small animals or other reptiles do not generally show much fear, or at least soon recover composure when thrown together with them; least of all will they bite other snakes. It is not very uncommon to meet on warm days in spring or autumn, rattlesnakes and racers (*Bascanion flaviventris*) sunning themselves entwined together near the entrance of some favorable hole. The prairie dog will pass by them and enter its burrow. Both of these snakes choose any convenient shelter for the time being, neither molested nor particularly avoided by the prairie dog and owl. When fortune favors them they readily devour the young squirrel, and more than one at a meal; but their more usual food is the ground-nesting birds, rats, mice, ground squirrels, etc. In one moderate sized rattlesnake, whose stomach I examined, were found a freshly killed ground squirrel, and slum lark, together with a half digested lark finch (*Chondestes grammaca*).

The rattlesnake is slow and sluggish in his movements, and prefers shelter in damp or cold weather. When intent upon prey he is less readily induced to rattle, but at other times his stroke is usually preceded by a warning. When mating during May they are more vicious than at other times. The danger from the rattlesnake's bite has been popularly over-estimated. I have observed a great many cases among the larger animals; fatal results have been the marked exception. Among horses and cattle not one case directly fatal has come within my notice.

In man, in eleven cases there were three deaths, two of which were most probably through ignorance or improper attention.

The rattlesnake is not dependent upon vision alone in detecting danger; his warning rattle may often be heard while yet he is entirely concealed, having been apprised of intrusion either by the sense of hearing or by mere tractile vibration.

In addition to the owl and the snake, there are still other dwellers in the burrows of the prairie dogs, but they are very useful little scavengers, though only beetles. Six or seven species of *Eleodes* and *Asida* are always found near the burrows, and one or two are almost peculiar to them.

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RAMBLES OF A BOTANIST IN NEW MEXICO.

BY EDWARD LEE GREENE.

II.

THE neighborhood of the old copper mines furnishes the best of ground for studying the imperfectly known and therefore very interesting sylva of the remote south-west. The number of species belonging to genera which make up forests in other countries is very considerable, and yet there is nothing in all this region which merits the name of a forest; nothing which an emigrant from "the States" would call "a piece of good timber." Of oaks, for example, there are four species, but one of which attains the dimensions of a middle-sized forest tree; this is Gambel's oak (*Quercus gambelii* Nutt.), a deciduous tree with something of the habit of the Wisconsin burr oak, but having foliage and acorns more like those of the common white oak. It grows rather sparingly in the little valleys among the higher hills, and is about the only oak of the region whose wood is good for any-

thing but fuel. Another kind of white oak common on all the hill-sides near the plains is of a low but stout habit, showing a trunk a foot or two thick but rarely attaining a height of twenty feet. Its leaves are oblong in outline, small and of a rather leathery texture, not deciduous, but remaining on the tree until the appearing of the new ones in April. Emory's oak (*Q. emoryi* Torr.) is a small but rather handsome tree. It has hitherto been erroneously classed with the white oaks, owing to the insufficient material brought in by the various explorers who had seen it; but it rarely takes rank among the blackest of the black oaks. Its bright-shining lance-shaped leaves remain green all winter, falling, like those of the species mentioned above, only when the new ones are appearing in spring. The fourth species of the genus, found away upon the summits of the Santa Ritas (*Q. hypoleuca* Engelm.), though a mere bush is very unique and pretty, with narrow laurel-like leaves which are dark and shining above, and on the under surface beautifully clothed with a fine dense-white wool. The bush is perfectly evergreen. The black walnut of the region (*Juglans rupestris* Engelm.) is a small species with nuts differing from those of its eastern congener, though the wood is quite similar; but lumbermen rarely find a trunk of this walnut large enough to be sawn into boards. The pines, with the exception of the tall yellow pine (*P. ponderosa* Dougl.) which occurs rather sparingly on the more elevated mountains, are of the dwarf nut-bearing sorts (*Pinus edulis* Engelm., and *P. chilua-hua* Engelm.) called piñon by the Mexicans, of little value except for their oily and nutritious nut-like seeds. The very graceful willow-leaved cottonwood (*Populus angustifolia* James) frequents the banks of streams, makes a beautiful shade tree, is largely employed for that purpose on the streets of the young New Mexican towns, but is not otherwise very valuable. And here where oaks, pines and walnuts, the *large* trees of other countries, appear only in the shape of dwarfs, the junipers, which in other regions are usually small, develop into trees of very respectable size. It seems a favorite soil for junipers, for we meet here the leading species of the east (*J. virginiana* L.) and its ally of the Pacific coast (*J. occidentalis* Hook), besides a fine species peculiar to the interior south-west, which is remarkably different from both (*J. pachyphlæa* Torr.). This is an oddity among junipers by having instead of the dark red very fibrous bark common to most

of them, a trunk so clothed in light ash-gray that at a little distance it looks almost precisely like the trunk of a white oak. Mexicans, much averse to the hard work of swinging an axe, never undertake the operation of cutting down even a medium sized tree of any sort; they prefer, when wood is wanted, to climb the trunk and cut off the branches; thus in the vicinity of any Mexican village among these hills, one sees instead of low stumps, trunks standing ten or fifteen feet high simply divested of their arms or branches. Where white oaks and this juniper had grown side by side it was hardly possible to distinguish between them in the absence of the branches so closely does the one imitate the other as to the appearance of the bark. I took the measurement of a vigorously growing not old-looking specimen of *Juniperus pachyphlœa* and found the circumference of its trunk, at three feet from the ground, fifteen feet and three inches. The height of the tree was a little more than forty feet. The berries of this tree are light-green with a blue bloom when mature, and are full four times the size of ordinary juniper berries. They are sweet and not unpleasant to the taste, and as an article of food seem to be greatly enjoyed by various birds and mammals, and by the Indians. Among the small trees of the region the mountain mahogany (*Cercocarpus parvifolius* Nutt.) is valuable on account of its very hard wood, for nearly all the rest of the native woods, even that of oaks, is light and brittle. The New Mexican locust (*Robinia neomexicana* Gray) is another small tree, or sometimes a mere shrub, remarkable not from any utilitarian point of view but for its great beauty when loaded with its heavy pendant racemes of rose-purple flowers. No other North American locust is so highly ornamental. But perhaps the most beautiful flowering tree of this section and of the whole south-western country is the one known to the Americans by the common name of desert willow (*Chilopsis linearis* DC.). The appellation sounds paradoxical surely, for from the ancient Hebrew poets down to the present generation, all, even superficial observers, know that the place for willows is not in deserts, but "by the water courses." And the tree in question is not indeed a willow, though the Mexicans have made the same mistake as we, for they call it the *mimbre*, which is the Spanish word for osier. But with its black bark, like that of some species of willow, and its long narrow leaves clothing slender and gracefully-

drooping boughs, it is well enough named desert willow, though it belongs technically to a very different order of trees. The catalpa of the south-east is its nearest ally. The flowers of the two trees are much alike in form and size, but those of Chilopsis are bright deep pink color with purple markings; and clustered among the willow-like foliage on branches that droop and sway with every breeze, they place the species far superior to the catalpa in point of grace and beauty. We hardly meet with it in our mountain saunterings, nor even along the banks of the Rio Mimbres, which pretty stream, flowing along the eastern base of the Santa Ritas, takes its Spanish name from the real willows which overshadow its clear and rippling waters. Only beyond the mountains on the sandy plains, though indeed in the lowest parts of them, along channeled sands where water sometimes flows after a heavy shower, do we find the shade of the branches and inhale the pleasant fragrance of the flowers of the desert willow. One cactus of the plains, which attains the dimensions of a small tree (*Opuntia arborescens* Engelm.), maintains a foothold among the rocks in the cooler, fresher region of the mountains, and in spite of its defiant aspect, armed thickly as it is with stout needle-pointed spines, it is a splendid object late in June when every branch bears at its apex a cluster of very large brilliant magenta blossoms. Another of a different genus (*Cereus fendleri* Engelm.), is a humbler tenant of the rocks, with still more beautiful flowers. Of the two species of Yucca noticed, one (*Yucca angustifolia* Pursh) merits the name of a true lily, growing as it does to the height of twelve or fifteen feet, the large panicles of nodding white lily-like flowers sometimes of themselves measuring six feet long. It is a majestic plant when in bloom, though less to be admired at other seasons, when it displays a mere branchless trunk terminating in a single tuft of long narrow leaves. In this last-named condition a group of yuccas seen at a distance on the plains has a singular likeness of a band of long-haired south-western savages, and has often been at first sight mistaken for such by travelers newly coming into these sub-tropical regions. The other member of this genus (*Y. baccata* Torr.) is of humbler growth, and its flowers are succeeded by edible fruits looking a little like bananas and having the flavor of pawpaws, together with slightly cathartic properties.

I read one day in an eastern newspaper a notice that a century

plant was about to flower in some one's conservatory in an eastern city. The plant is well known to be a native of old Mexico. I had seen many forms of it growing along the Rio Gila in Arizona, where it constitutes, together with stately yuccas and giant cacti, a marked feature of the landscape. Here, near Santa Rita del Cobre, I had in my rambles come upon several localities where a fine large form of it was abundant. In May I had observed the starting up of the flower stalks from the centres of such as were to flower this year. Now, near the end of June, I set forth one morning in the direction of the nearest locality of the plant which I had remembered, expecting to see them in bloom. My anticipations were realized after an hour's ride. On coming within sight of the mountain side where they grow, the great branching stems were visible, each branch terminating in an umbel of greenish yellow. I rode up to the nearest specimen, but was unable to reach, from the saddle, the lowest branch of the gigantic panicle. In the act of tying my horse to another of them I was surprised by the fall of an abundant shower of honey. Every one of the great mass of tubular flowers was filled with a clear, rather fetid liquid, very sweet, however, to the taste; and a jarring of the great stalk was sufficient to bring down mellifluous rain more copious than agreeable. This New Mexican species is not identical with the century plant common in cultivation, but is probably new and undescribed. During the weeks of my delightful sojourning in the Santa Ritas my favorite rambles were along the streamlets that come, I had almost said running, but rather dripping, down from among the higher peaks and ridges. The smaller of these are commonly lost among the rocks midway between their sources and the plains below; and the best of them sink into the thirsty ground as soon as they get fairly down out of the mountains. Nothing less than a great river could preserve itself and get across those sun-burnt, rainless tracts that separate the different mountain districts of the southwest. It was charming however, when among the hills, to go up several miles of some ravine where a scanty rill came trickling down. On one side, that which sloped northward, one could proceed under the shade of pines, oaks and cedars and salvias blue or scarlet-flowered, purple clematis climbing up among wild cherry bushes, and other delicate shade-loving plants peculiar to the region. On the opposite side where the slope was to the

hot sunny southward, one saw no trees, nor plants of fine or graceful habit, but only yuccas, century plants, cactus and Dasylirion, adorning with rigid and stately magnificence the otherwise almost barren rocks. On less rugged portions of these hot unshaded hills is where we look for and find various species of an interesting genus (*Dalea*) of peculiar south-western leguminous plants. Some are herbs, others shrubs, with small, *very* small ferny foliage and a profusion of yellow pink or purple corollas set usually in exquisite white-feathery calyces. Another characteristic and very abundant shrub of these ravines and hill sides is an oddity of the rose family (*Fallugia paradoxa* Torr.), in which the flower of a rose, or it might rather be called that of some large flowered raspberry, or blackberry (*Rubus*), is succeeded not by a berry of any description, but by a close tuft of dry seeds with long silky tails, much like those of a clematis, but finer and more graceful, and of a purplish hue. They are borne in great profusion and the bush is more showy in seed than in flower. But passing upward beyond where all these interesting things are found, we come to higher, more open and smoother lands at an altitude where snows are more sure to fall in winter, and showers in summer are more frequent. Here are scattered pines of larger growth, and under them grasses are abundant and the wild deer graze in safety; masses of blue lupines, with here and there a tall stalk of flame-red pentstemon (*P. barbatus* Torr.), occupy the more open grounds, while, farther upward still, the ravine narrows to a gorge a few rods wide. Here we find our streamlet a brook shaded by alders and poplars, and the dripping precipices are clad with mosses, mimuli and saxifrage, reminding the herbalist here upon the borders of Mexico of familiar scenes in far northward latitudes.

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ON THE TRANSFORMATIONS AND HABITS OF THE BLISTER-BEETLES.[1]

BY CHAS. V. RILEY, A.M., PH.D.

THE larval habits of the European Cantharis of commerce, as also those of its congeners in our own country and in other parts of the world, have hitherto remained a mystery, notwithstanding the frequency with which the beetles occur, their great

[1] Adapted by permission from the Transactions of the Academy of Science of St. Louis.

abundance at times, and their commercial value and interest. The same remarks hold true of the allied genera *Macrobasis*, *Epicauta* and *Henous*, the species of which have the same valuable vesicatory properties as *Cantharis*. Some of these species are very common in the United States, and quite injurious to vegetation, swarming at times on potato vines, beans, clematis, and other plants. Their great numbers and destructive habits make it all the more remarkable that so little has hitherto been discovered of their early life. Harris, who evidently had hatched the first larva of the Ash-gray Blister-beetle (*Macrobasis unicolor* Kirby), says: "The larvæ are slender, somewhat flattened grubs, of a yellowish color, banded with black, with a small reddish head, and six legs. These grubs are very active in their motions; and appear to live upon fine roots in the ground; but I have not been able to keep them till they arrived at maturity, and therefore know nothing further of their history." (*Ins. inj. to Vegetation*, p. 138.) Latreille, according to Westwood, states that the larvæ live beneath the ground, feeding on the roots of vegetables (*Intr.*, vol. i., p. 301), but the statement is evidently founded on conjecture. Ratzeburg, who well describes the method of oviposition of the European *Cantharis vesicatoria*, and roughly figures the first larva (*Forst Insecten*, II, Col. Taff. ii, fig. 27 *B*), believed that it was a plant-feeder in the immature state. Olivier describes what is possibly the second larva as a soft, yellowish-white, 13-jointed grub, with short filiform antennæ, and short, corneous, thoracic legs—"living in earth" (*Traité Elém.*, etc., M. Girard, Col., p. 618); but his account is very loose, and may apply to any number of other coleopterous larvæ. Audouin, who studied the Cantharides intently, making them the subject of his thesis in his medical examination, was obliged to confess that absolutely nothing was known of their larval history. This is about all we learn from the older authors, and more recent writers have shed no further light upon the subject; Mr. Wm. Saunders, of London, Ont., in a paper on these insects, read at the 1876 meeting of the American Pharmaceutical Society, being unable to add anything more definite. Among the early writers the opinion was general that the Blister-beetle larvæ in question were vegetable feeders, like their parents. In 1874 Laboulbène mentioned the fact (*Ann. Soc. Ent. de France*, 1874, lxxxiii) that some one (name not given) had seen the European *Cantharis vesicatoria*

issuing from the ground in the neighborhood of which there were wasps (*guêpes*—no specific reference given), and rashly concludes that the former were parasitic on these. Still more recently M. J. Lichtenstein, of Montpellier, France, has endeavored to discover the larval habits of this species, and gives some reasons for believing that it develops in the nests of *Halictus*.[1]

These facts, as well as analogy, pointed to a parasitic life and partly carnivorous, partly mellivorous diet for our own allied species, since the life-history of two genera in the family, viz: *Meloë* Linn. and *Sitaris* Latr., has been fully traced. Indeed, the young of all vesicants belonging to the *Meloidæ*, so far as anything has yet been known of them, develop in the cells of honey-making bees, first devouring the egg of the bee and then appropriating the honey and bee-bread stored up by the same. They all are remarkable, in individual development, for passing through seven distinct stages, viz: the egg, the first larva or *triungulin*, the second larva, the coarctate larva or pseudo-pupa, the third larva, the true pupa, and the imago. They are further remarkable in that the first pair of spiracles are distinctly mesothoracic and dorsal in the triungulin.

History of Meloë.—The history of *Meloë* may be briefly summed up as follows: The newly hatched or first larva (now generally called *triungulin*) was first mentioned in 1700 by the Holland entomologist Gœdart, who hatched it from the egg. Frisch and Réaumur both mistook it for a louse peculiar to bees and flies. De Geer, who also obtained it from the egg, mentions it in 1775 as a parasite of Hymenoptera. Linnæus called what is evidently the same thing, *Pediculus apis;* Kirby, in 1802, described it as *Pediculus melittæ*, and Dufour, in 1828, named it *Triungulinus andrenetarum.* Newport, in 1845 (*Trans. Linn. Soc.*, vol. xx, p. 297), first rightly concluded that it was carried into the nests of bees, and described, in addition, the full-grown larva from exuvial characters, and the coarctate larva and pupa which he found in

[1] Quite recently (*Comptes Rendus de l'Ac. des. Sc.*, Paris, Oct. 11, 1877, p. 628) he has succeeded, by furnishing the larvæ of *C. vesicatoria* with artificial nourishment composed of the filled stomachs of honey-making bees, and especially of *Ceratina*, in tracing the development from the triungulin to the coarctate larva, which last differs from those of the other species considered by me, in freeing itself entirely from the second larval skin. He has thus established the fact that *Cantharis* agrees with the other species of the family in its hypermetamorphosis; but its natural habits remain as much as ever a mystery.

the cells of *Anthophora retusa*. He failed, however, to fill the gap between the first and full-grown larva; and this Fabre first inferentially did in 1858 (*Ann. d. Sc. Nat.*, Zoöl. t. ix, p. 265) by tracing the analogous stages of *Sitaris*.

The female *Meloë* is very prolific. She lays at three or four different intervals, in loose irregular masses in the ground, and may produce from three to four thousand eggs. These are soft, whitish, cylindrical, and rounded at each end. They give birth to the triungulins, which, a few days after hatching—the number depending on the temperature—run actively about and climb on to Composite, Ranunculaceous and other flowers, from which they attach themselves to bees and flies that visit the flowers. Fastening alike to many hairy Diptera and to Hymenoptera which can be of little or no service to them, many are doomed to perish, and only the few fortunate ones are carried to the proper cells of some *Anthophora*. Once in the cell, the triungulin falls upon the bee egg, which it soon exhausts. A molt then takes place and the second larva is produced. Clumsy and with locomotive power reduced to a minimum, this second larva devours the thickened honey stored up for the bee larva. It then changes to the pseudo-pupa with the skin of the second larva only partially shed; then to a third larva within the partially rent pseudo-pupal skin, and finally to the true pupa and imago. These different changes of form are known by the name of hypermetamorphoses, the term first given them by Fabre to distinguish them from the normal changes from larva to pupa and imago, experienced by insects generally. The triungulin or first larva (Fig. 1, *a*) is characterized by a prominent labrum, very stout thighs, unarmed shanks, three broad and subspatulate tarsal claws, feeble and reduced trophi, untoothed jaws, 3-jointed antennæ, ending in a long seta, and four anal setæ, the two inner ones longest. When

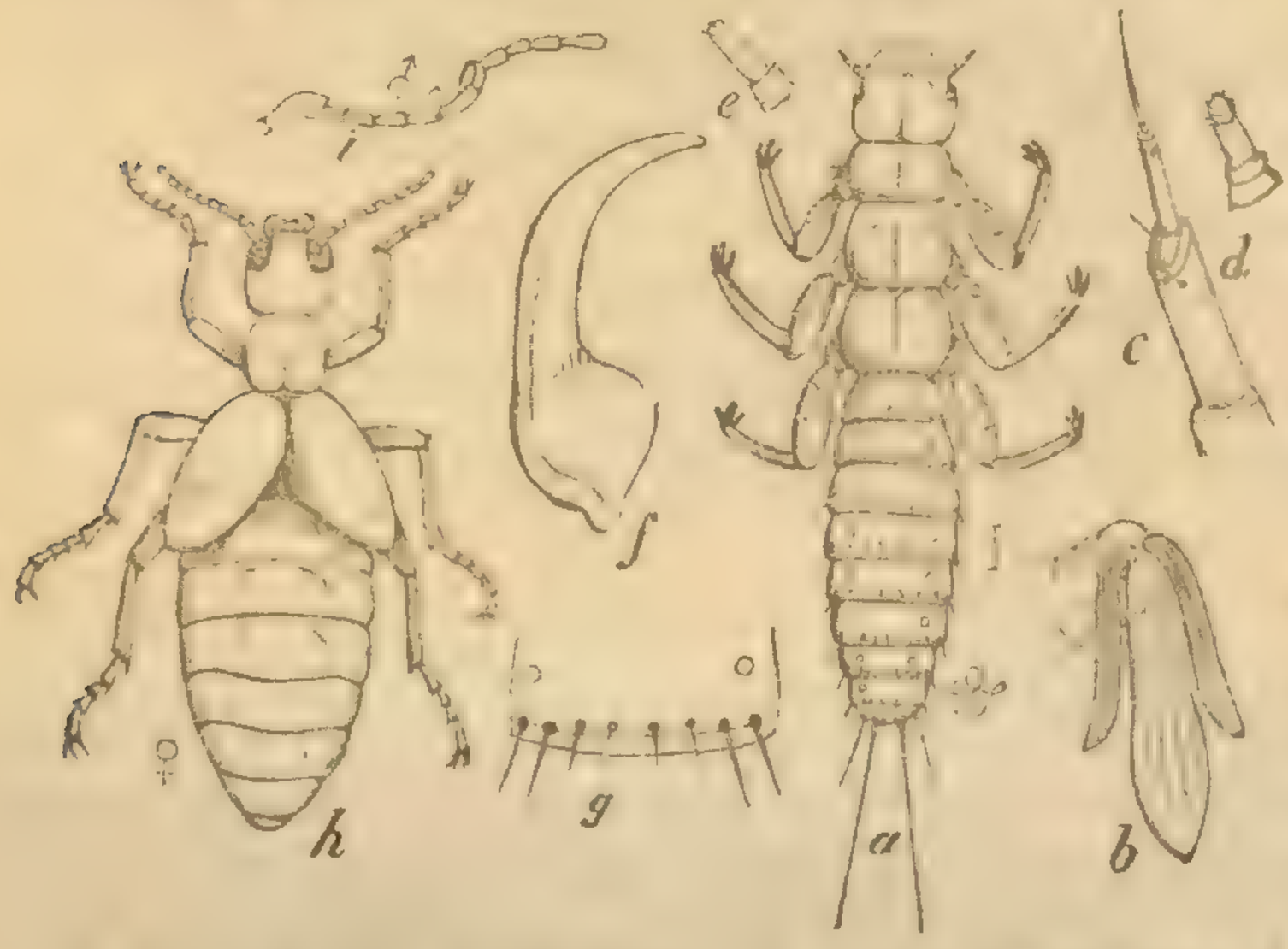

Fig. 1.—*Meloë*; *a*, first larva; *b*, claws; *c*, antenna; *d*, maxillary palpus; *e*, labial palpus; *f*, mandible; *g*, an abdominal joint; *h*, imago ♀; *i*, antenna of ♂.

the abdomen is shrunken the general aspect is very much that of *Pediculus*, and it is hardly surprising that some of the early describers so determined it.

History of Sitaris.—The history of *Sitaris* is also well known and agrees very closely with that of *Meloë*. Its first larva was figured many years ago by Westwood (*Introduction*, etc., fig. 34, 5) from specimens obtained from Audouin, who found the female *Sitaris* in the cells of *Anthophora* enclosed in its thin pseudo-pupal and second larval skins, which Audouin erroneously took to be the pellicle of the devoured bee-larva. But the complete life-history of the genus was first given by Fabre in 1857 (*Ann. d. Sc. Nat.*, Zoöl., t. vii. p. 299; t. ix. p. 265), who studied the *S. humeralis* Fabr., while that of *S. colletis* V.-M. has been more recently given by M. Valery-Mayet, of Montpellier, France (*Ann. Soc. Ent. de Fr.* 1875, p. 65), from whom I have specimens in all stages. The former species infests the nests of *Anthophora*, the latter those of *Colletes*. In the former the newly hatched larvæ hybernate in huddled masses in the galleries of the bee; in the latter they hybernate in the bee-cell, slowly feeding while the temperature permits; but such differences doubtless depend on the relative earliness in the autumn that the eggs are laid. The first larva or triunguiin (Fig. 2, *a*) agrees very much in the head, tarsal and general characters with that of *Meloë*, but differs in several important particulars, and especially in having a pair of pre-anal spinnerets, from which is secreted a serous, sticky fluid, which aids the animal in holding firmly to the bee that is to carry it into the nest. A pre-anal pair of claspers also assist in this work. The hypermetamorphoses are very similar to those of *Meloë*. The triungulin after absorbing the contents of the bee egg, molts, and thereafter floats upon and devours the honey—the pseudo-pupa, third larva and true pupa all forming in due time within the second larval skin. The female does not feed, and on account of her heavy

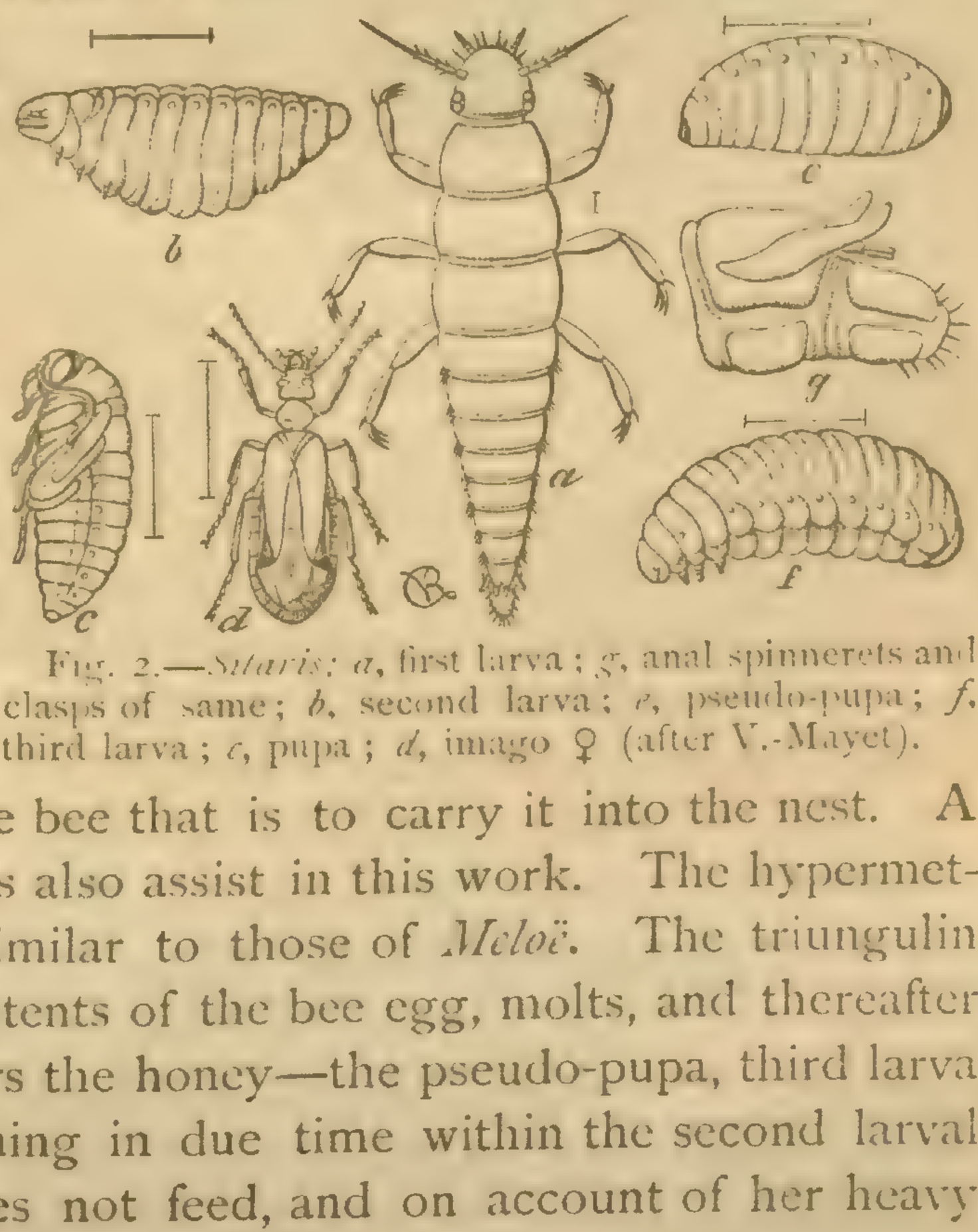

Fig. 2.—*Sitaris*: *a*, first larva; *g*, anal spinnerets and clasps of same; *b*, second larva; *e*, pseudo-pupa; *f*, third larva; *c*, pupa; *d*, imago ♀ (after V.-Mayet).

abdomen travels but a short distance from the bee-burrows where she developed.

History of Hornia.—While the natural history of none of our N. A. species of *Meloë* has been traced or recorded, they will, beyond all doubt, be found to agree with their European congeners in their partial parasitism on Mason-bees. In examining the cells of *Anthophora sponsa* Smith, I have thus far failed to discover that *Meloë* is parasitic upon that species, but *Meloë* is in reality very rare around St. Louis. I have, however, found on four different occasions in the Fall, within the sealed cells of the bee mentioned, a very interesting and anomalous Meloid (*Hornia minutipennis* Riley), which may be taken to represent the typical partial parasitism of the family in the United States. There is a tendency in the family to wing reduction, but in no hitherto described species is the reduction carried to such extremes as in this (Plate 1, fig. 13) both sexes having the elytra as rudimentary as in the ♀ of the well-known European Glow-worm (*Lampyris noctiluca*). Another characteristic feature is its simple tarsal claws, which, together with the rudimentary wings and the heavy body, show it to be a degradational form. *Anthophora sponsa*, its host, builds mostly in steeply-inclined or perpendicular clay banks, and, in addition, extends a tube of clay from the entrance. The burrow of this bee has usually two branches which decline about an inch from the surface of the bank, and six or eight cells are arranged end to end. By means of saliva the inside of the cell is rendered impervious to the moisture of the honey and bee-bread stored in it for the young. It is evident that this clumsy Meloid will have difficulty in crawling out of or about the cells, and it is probably subterranean and seldom, if ever, leaves the bee gallery. The male can climb and drag his body, but with some difficulty, up a steep surface if rough, and, as he does not leave the bee-cell till spring, when the *Anthophora* tubes are very generally broken and have fallen, he may possibly wander a short distance from the mouth of the bee-burrow; but the female will naturally possess less power of locomotion. The triungulin is yet unknown, but the ultimate stage of the second larva as well as the coarctate larva, as shown by the distended and unruptured skins, exhibit the ordinary family characteristics, the legs and mouth-parts being atrophied in the former, and merely tuberculous in the latter. The lateral ridge, as found in

Epicauta and *Meloë*, is not conspicuous, and in this respect, as well as in the final transformations taking place within the two unrent skins, the insect approaches *Sitaris*. In the hairless and unarmed surface of the second larva, and of the third larva and pupa, as shown by careful examination of their shrunken exuviæ, the insect also resembles that genus.

[*To be continued in May Number.*]

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THE PREPARATION OF ROCKS AND FOSSILS FOR MICROSCOPICAL EXAMINATION.

BY R. FRITZ-GAERTNER, PH.D.

IT is often supposed by those who have never prepared sections of rocks or fossils that the process is associated with great difficulties and expenditure of time, but this in reality is not the case. A small amount of practice is needed for the beginner and he may soon be able to manufacture sections which are fit for the microscope. The time spent in the mechanical operation of grinding rocks is not only remunerated by interesting and instructive preparations, but adds also to a complete knowledge of their physical structure, gained by a close observation of the various features they present during the process of preparation.

In cases where large numbers of sections are to be prepared it is not possible for the lithologist or palæontologist for want of time to perform all the work himself: he may be assisted by any person of ordinary ability in the preliminary part of preparation. Those who do not personally wish to prepare sections can be referred to Mr. Fues, of Berlin, or to Mr. A. Julien, School of Mines, New York city, who prepare and deal in sections, which, on account of their perfection, deserve commendation.

In the present article I wish to describe the process of preparing rocks or fossils for microscopical study. They are mainly intended for those who design to make sections themselves, and to whom a detailed description of a mechanical operation may be of some assistance in their first attempts.

Selection of Rock Material.—It is quite important in order to make a complete microlithological analysis of rocks to select material which is characteristic. Most rocks are in various states

of alteration; it is therefore necessary to choose fragments both from the fresh and decomposed parts, as thin sections of the latter ones are just as important and instructive as those taken from parts in which no visible change has occurred. Usually such decomposed rocks are very fragile and crumbling, because their crystalline structure or their cementing medium has been destroyed by the process of decomposition. Before undertaking to grind them their firmness must be restored. The fragments of such decomposed rocks are at first well dried and then placed in liquid Canada balsam, which is exposed on an iron plate to a gentle heat till it has filled and penetrated the pores and fissures of the rock. They are then separated from the Canada balsam and laid upon the warm iron plate till the balsam proves to be hard when cooled down, and are then capable of undergoing the process of slicing or grinding.

Apparatus.—It consists in its most simple form of some plates of iron and glass about eighteen inches square, to allow a full stroke with the arm during the grinding process. They have to be perfectly even and flat. Emery of various degrees of fineness is required to be used on the plates with an addition of water. Fragments of rocks are ground by hand and treated as will be described in the following lines:

In the New York State Museum of Natural History at Albany, where a large number of rocks and fossils have to be cut and prepared for thin sections for illustrating the Palæontology of New York, the slow process of grinding by hand had to be abandoned, and a small boiler and steam engine of two and a-half horse power were purchased for the purpose of using steam-power for the grinding and slicing operations. The grinding apparatus is formed by two circular iron plates (A and B) of eighteen inches diameter and one-half inch thickness, which rotate horizontally with a velocity of about 300 revolutions a minute. The slicer which is used to cut the rock in certain directions, or to separate from it small slices to be ground afterwards, is a thin copper or steel disk of twelve inches diameter, and turns also horizontally with the same velocity as the grinding plates. For rocks above hardness 5, another slicer of steel is used, which turns vertically, and which is fed with diamond powder moistened with oil.

The whole apparatus may be run at the same time, and is

arranged in such a manner that no one operation interferes with another.

The grinding and slicing is performed by the aid of emery, which is constantly applied to the plates and slicer with a brush held in the left hand. The plates are kept wet by a small current of water. It is important to use emery of different but uniform degrees of fineness as the work progresses. A mistake usually made by beginners is to choose a too coarse emery, in order to hasten the work of grinding, but they soon discover that all their sections break and wear off long before being half finished. It is advisable to use for the coarse grinding on plate A an emery which can be bought in any drug store as emery No. 90 (A). Plate B is charged with flour of emery (B); it serves also to prepare one or two sorts of finer emery from it, by treating a certain quantity of the flour with water in a vessel which may be about three feet high and six inches in diameter. In stirring the water, the emery becomes suspended in it; after a lapse of fifteen minutes the water with emery which has not settled down during this time is decanted in a similar vessel and left there for twenty minutes more, when the water may be drained off. A sediment of fine emery will thus form in the latter vessel; and after having repeated the process for some time the emery sediment (emery C) is taken from the vessel, dried and bottled. Its degree of fineness is expressed by the number of minutes, which is in this case fifteen minutes.

Canada balsam serves as a cementing medium, it also is used to increase the transparency of various sections. It should be entirely clear and not of yellowish tint. Usually a solution of Canada balsam in turpentine is employed to mount such rocks as will not undergo any change in heating them gently over a warm plate of iron. For rocks which cannot be exposed to any heat, a solution of pure Canada balsam in chloroform is used. Both solutions of Canada balsam should be well bottled to prevent evaporation.

Object Glasses.—The slides of glass which are intended to bear the section should be entirely clear, free of any color, air bubbles or any other enclosures, as those which are used in other branches of microscopy. Their size should be uniform. Prof. Zirkel, of Leipzig, the distinguished lithologist, has proposed and introduced the following size, 45 *mm. by* 25 *mm.*, which is preferable to the

ordinary 3 *by* 1 *inch*, as a slide 45 *mm.* by 25 *mm.* can be rotated on the table of the microscope; besides they are less liable to break in dropping them, and also take up less room.

In the New York State Museum of Natural History the slide measuring 45 *mm.* by 25 *mm.* is adopted. As it was found that this glass slide was too small for a number of sections of fossils, which exceed the usual size, two other standard sizes were introduced which are in proportion to the first. Size B is twice the size of first = 50 *mm. by* 45 *mm.* Size C is twice the size of second = 50 *mm. by* 90 *mm.* It would be of great advantage if a uniform size was introduced in the various collections of those who prepare sections. The slide 45 *mm. by* 25 *mm.* is generally adopted with lithologists and palæontologists both in America and Europe.

Process of Slicing and Grinding.—The fossil or rock is at first marked with a pencil and afterwards with a file in the direction in which it is designed to be cut. It is then held with the right hand without any further apparatus, in such a direction that the revolving slicer will cut the specimen according to the marked line. The slicer is constantly supplied during the operation with flour of emery and water. If there is plenty of material and no special direction needed, small slices can be separated from the rock by a heavy blow with a hammer. The rock fragments should as a rule not be beyond the size of a twenty-five cent piece; of course it is of great advantage to prepare sections which offer a large field for observation, and the rock specimens should not be chosen too small, as they lose in size during the grinding process.

The slice of rock which has been separated either by the slicer or by the heavy blow with a hammer, is gently pressed with the right hand against the turning plate A, while the left hand supplies plate A with emery A and water. It is necessary to change constantly the position of the rock-slice in the right hand in order to grind it to an even and plain surface. The slice is then well rinsed and cleaned of any particle of emery A, and then transferred to plate B (emery B) where the grinding proceeds till its surface is free of any scratches. Being cleaned of the emery B, it is brought upon glass plate C (emery C) and ground till its surface is entirely smooth. The rock section is finally well rinsed and brushed to clean off all impurities and allowed to dry.

Mounting Process.—A slab of iron two and a half feet long, four inches broad and half an inch thick is laid horizontally upon a tripod (of iron) and heated with a Bunsen burner. The glass slide on which the rock fragment is to be mounted is well cleaned and laid upon a part of the slab which is of a constant and moderate heat; after being warmed a few drops of Canada balsam are placed upon the glass and left with it on the slab till the balsam by evaporation has assumed a tenacious condition, in which its films will not adhere much to the fingers and yet be pliable enough to be bent readily without breaking. The warmed mineral slice is now laid upon the Canada balsam with its ground face down, and allowed to remain on the slab till all air bubbles have disappeared below the slide in the balsam. It is then gently pressed on the glass and then taken off and allowed to cool. It is of great importance to use Canada balsam in its above described condition, as the rock section during the process of grinding thin unavoidably breaks to pieces in case the balsam proves to be too soft, and if on the contrary it has been too long exposed on the slab it will become brittle and the section will, during the grinding, be liable to break off. The loosened mineral slice must in such a case be laid into a dish with turpentine to dissolve the balsam, and after being well cleaned is mounted again as described. There is no considerable difference in the process of mounting with balsam in solution with chloroform or with turpentine. The balsam in chloroform is allowed to harden in a warm room: it usually needs one or two days, while the solution in turpentine by application of heat hardens in from five to ten minutes. In the latter case care should be taken not to heat the balsam too quickly, as it turns yellowish on account of a partial carbonizing.

Grinding Operation.—After having used all necessary precaution in cementing the rock fragments to the glass, the grinding manipulation now begins on the reverse side of the section. It is ground at first on plate A (emery A), then on plate B (emery B) till the section commences to be translucent, or till it is so thin that it is not advisable to continue the process on the rotating wheel. It is, of course, only a matter of experience to know how long to use the various wheels, as much depends on the consistency of the rock material. It is advisable to discontinue the use of plate B before the slice is too much reduced in thickness, so

as to allow a further treatment on glass plate C with the fine emery C. Due precaution should be employed so as not to grind the section uneven. To avoid this the position of the section should frequently be changed in grinding. The section is ready as soon as it is thin enough to allow a complete study of its texture and its component parts, of which a preliminary examination under the microscope will be the best test.

Process of Covering and Remounting.—The section is well rinsed and brushed to remove any emery which might have remained on the glass or which may be accumulated in the pores or fissures of the slice. It is then laid in a vessel with turpentine in order to dissolve the excess of Canada balsam around the slice. In a few minutes it will be softened enough so as to be easily removed by a gentle brushing with turpentine, after which it is well washed and then dried with chamois leather. In order to protect the section and also to increase its pellucity, it is usually imbedded in balsam and covered with a thin glass, the thickness of which should not exceed 0.25 *mm.*, to allow the use of a high magnifying power.

Usually the glass slide on which the mineral slice has been cemented to grind it thin, becomes partly ground during the various operations. It may be replaced with a clean slice on which the mineral slide is mounted as already described.

The separation of the section from the original glass is done by gently heating it till the Canada balsam becomes softened enough so as to allow the removal of the section by a slow sliding to a vessel with turpentine. The heating should be done very gently, otherwise a crust of hard Canada balsam will form around the sections, the removal of which by aid of turpentine or any other dissolving medium will be most difficult.

Another method consists in laying the glass with its slice in a dish with turpentine and to leave it there till the balsam is entirely dissolved, after which the slice of rock may be separated from its glass without any difficulty. The thin slice is transferred to another dish with turpentine and left there till it proves to be entirely free of any foreign matter. It is then taken from the vessel with the point of a knife, rinsed with alcohol and dried, afterwards mounted on a glass which has been warmed, when the slice may be placed upon it with a few drops of Canada balsam.

The whole operation of transferring needs great care, as

some mineral slices will prove to be very fragile on account of their thinness. Sections which are made of a rock material which needed a preliminary treatment with Canada balsam to make it firmer would break entirely to the smallest fragments in the attempt to remove them to another glass, and have therefore to remain on their original glass. Before covering them, the greatest care should be taken to free them entirely from any Canada balsam around the borders of the mineral section, and also from emery, which sometimes can only be detected by aid of a magnifying glass. The re-mounted mineral slice, or the one which could not be removed, as stated above, is covered with a few drops of Canada balsam and laid again upon the warm slab till the balsam has obtained the required tenacity. A thin cover-glass, corresponding in size with the mineral slice is cleaned with alcohol and warmed; it is then taken up with a pair of forceps and dropped slopingly on the slice so as to exclude any air. The section is left on the warm slab till all air bubbles have disappeared which may have been enclosed between the section and cover-glass; the latter is gently pressed upon the section and then allowed to cool. Care should be taken to place the mineral slice and cover-glass in the centre of the glass slide, which will contribute to a nice appearance of the finished preparation. The surplus of Canada balsam around the cover-glass is cleared off by brushing it with turpentine, then it is well rinsed with water and after being dried it should be labeled at once. The labels should be applied on both sides of the preparation and inscribed with the name and locality and geological group of the prepared material. It is well to number the sections and record them in a catalogue in which also a description of the most interesting and principal features of each mineral slice may be given, which will facilitate a future study of the section.

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THE SERPENT AND THE APE.

BY ARTHUR E. BROWN.

WITH the purpose of observing the manner in which the feelings of curiosity and astonishment are manifested in the monkey, Mr. Darwin once introduced a snake into a cage containing a number of those animals, and the results of his experi-

ment he refers to in "The Descent of Man," and also in "The Expression of the Emotions in Man and Animals," as illustrative of the extent to which those qualities are developed in that branch of the animal kingdom.

Reading his statement, the writer conceived the idea that the results obtained were capable of a deeper application than was then given them, and he proceeded to try the experiment for himself. The Monkey House at the Philadelphia Zoological Garden afforded the opportunity, so a dead snake was coiled up in a newspaper, the corners of which were twisted together in such a manner that they would readily come undone, and the package was then set on the floor of a cage containing forty or fifty monkeys of a great variety of species. It was instantly spied by a female *Cynocephalus*, who was the principal leader in all the pranks with which the monkeys constantly amused themselves; she seized the paper by one corner, and set off across the cage, dragging it behind her, evidently intending to have a good time with it.

Before she had gone more than a few feet, the paper became unfolded, and the snake slipped partly out. She instantly dropped the paper and sidled off in a very comical manner with her head over her shoulders, keeping an eye behind her, much as Lot's wife must have looked back on the fascinating terrors of the cities of the plain. No sooner did the rest of the monkeys perceive the dreadful object in their midst, than they approached, step by step, and formed in a circle of six or eight feet diameter, having for its centre the snake quietly coiled up on the floor. None dared, however, to touch it or to go beyond the established line of safety, with the exception of one large Macaque, the acknowledged leader of the cage, who cautiously approached and made an occasional snatch at the paper, apparently to see if the enemy was really as devoid of life as it appeared to her; all the others, meanwhile looking on in breathless attention.

At this point, a string which had previously been attached to the tail of the snake was gently pulled. The serpent lengthened slightly, and the monkeys fled up the sides of the cage, chattering and screaming like magpies; when they got to a safe distance they halted for observation, and after some moments, seeing no further sign of danger, they gradually returned, one by one, to their former position—the large ones in the front rank, and the smaller ones, crowded out by superior strength, forming behind and looking over their shoulders.

This was continued for some hours without the slightest change in the disposition of the monkeys—all of their actions showing a most intolerable fear of the snake, mingled with an attraction or curiosity which would not allow them to remain away from it. This was so universal that not one of the monkeys in the cage was entirely free from it.

The snake was finally taken out, and several other animals belonging to the same class were put in its place, but with very different results. Of a tortoise, for instance, and a small dead alligator, they were at first rather shy, but they at length began to touch them, and in ten minutes they were playing with them, and passing them from one to another with the greatest curiosity.

The same snake was then shown, in turn, to animals belonging to a number of other orders: Carnivores, Rodents, Ungulates, Edentates and Marsupials, but none of them paid it any special attention with the exception of a Peccary (*Dicotyles labiatus*), which, finding it to be dead, seemed disposed to make a meal of it.

Turning from the monkeys and watching, instead, the visitors to the Reptile House, it is evident that the instinctive fear and horror of the snake which is so common as to be almost universal with man, is closely allied to that which has been seen to exist among monkeys. Women readily develop this, as their emotions are more quickly responded to by gestures, than is usually the case in the other sex, and I was specially fortunate, a short time after the occurrence detailed above, in having an opportunity of observing the effect produced by the collection of snakes, upon a lady who was deaf and dumb—by the fact of her disabilities she was shut out, to a very great extent, from the influence—repressing, so far as the expression of the emotions is concerned—of free association with others, and the nature of her feelings was thereby rendered more evident. I was not at all surprised to trace in her, actions and gestures which resembled closely those which I had observed on the part of the monkeys; they evidenced the same fear, the same attraction and the same repulsion, and after watching for a long time, with an expression of the most intense disgust, the cage of Boas, she was at last led away by her friends, protesting that she wanted to stay.

Now if it be asked why this instinctive feeling should be developed in the *Primates* alone—it is probable that as the early dawnings of intelligence in the common ancestor of man and

monkeys began to surpass the power of receiving impressions which existed in other animals, he would be most liable to conceive great dread of that enemy which inflicted upon him wounds of a very different sort from those which he received from his own kind or from animals which approached more or less to his own form, and which also produced effects so subtle in their character and operation, that they would be apt to leave lasting impressions on those animals which were frequently subjected to witnessing them. It should be remembered, also, that the home of the monkey and the spot where, in all probability, the earlier *Primates* first saw the light, is in those regions of the earth which are most infested by numerous and venomous serpents.

These facts will at once suggest to all who put their faith in the theory of gradual development, that the fear of the serpent became instinctive in some far distant progenitor of man, by reason of his long exposure to danger and death in a horrible form, from its bite, and that it has been handed down through the diverging lines of descent which find their expression to-day in *Homo* and *Pithecus*. How strongly marked it is in the latter, the experiment detailed above, corresponding in each of its results with that of Mr. Darwin, bears testimony; and for the evidence of its influence on the mind of the former, turn to the story of the serpent in Paradise; to the signs and symbols of many ancient mythologies, and to the feeling which few men can deny to themselves when they are brought into association with even the most beautiful and harmless member of the order *Ophidia*.

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TRACES OF SOLAR WORSHIP IN NORTH AMERICA.

BY EDWIN A. BARBER.

In an article published in the October NATURALIST, entitled "On the Ancient and Modern Pueblo Tribes of the Pacific Slope of the United States," the writer made use of the following expression: "Both paid homage to the sun, or at least looked for a Messiah daily to come to them from the east," to which assertion exceptions have been taken by some ethnologists.

It is held by this class of scientists that the heavenly bodies were never deified by any of the American races. Granting this to be, in some degree, true: That the luminaries, collectively

or individually, were not elevated to the *highest* place in their worship, by any tribe or people in North America, yet the celestial orbs, nevertheless, figured prominently in the list of supreme objects of worship, and many *traces*, at least, of this form of worship are found in the religions of aboriginal races of all ages, from the oldest American people down to the tribes of the present day, especially among those versed in astrology or astronomy.

Although little is known of the Toltecs of Ancient Mexico, it is an established fact that astral worship existed among them. They paid homage to the sun and dedicated their earliest temples to him. The moon, also, they reverenced as his wife and the stars were believed to be his sisters, according to the Mexican Licentiate, Don Mariano Veytia, in his "*Historia Antigua.*" The same writer describes the ruins of San Juan Teotihuacan, the most ancient architectural remains of Mexico, situated about thirteen miles north-east of the capital city. Of these, the largest pyramid, which measured six hundred and eighty feet in length at the base and was estimated at two hundred and twenty feet in height, was dedicated to Tonatinh or Tonatricli, the sun; the next structure in size and importance was inscribed to Meztli, the moon. On the summit of the former a temple was erected, in which was placed an immense statue representing the sun, which faced toward the east.

According to the accounts of Bernardino de Sahagun, a Spanish writer of the sixteenth century, and one who was particularly cautious in his deductions and entirely reliable in his accounts of the religion of the Aztecs, as set forth in his "Historia Universal de Nueva España," solar and lunar worship occurred in the Aztec religion, the sun with them being a spiritual conception. They believed that the heroes who fell in battle or died in captivity, or women who died in childbirth, were immediately transported into the House of the Sun, where they led a life of everlasting delight. From the broad tops of their *teocallis* or temples, the Aztec priests were in the habit of performing impressive, and, in too many cases, bloody ceremonies, in which the heavenly bodies were made to take a prominent part.

After the fall of the Mexican Empire, traces of sun worship were common. Captain Fernando Alarcon, in the year 1540, mentioned having met, on the Colorado River, Indians who worshiped the sun.

The same custom exists among the modern Pueblo Indians of New Mexico. Lieut. A. W. Whipple says of these people that "they are now anxiously expecting the arrival of Montezuma; and it is related that in *San Domingo* (one of the nineteen Pueblo towns), every morning at sunrise, a sentinel climbs to his house-top, and looks eastward, to watch for his coming."

Mr. Whipple also gives a tradition[1] of these Indians which assigns *Acoti* (another Pueblo village, situated on the Rio Grande del Norte, the ancient Tiguex) as his birth-place; but the tale is so at variance with facts and so rich in imagination that it is evidently the invention of some fertile brain. The Spaniards who came among the Pueblos, just after the Mexican conquest, about the year 1539, evidently introduced the name of Montezuma and probably instilled into their minds this idea of his second advent. Thus the worship of heavenly bodies may have become blended with the deification of ancestors; then the sun may have taken the name of Montezuma. Whipple further states that they "smoke to the sun that he may send them antelope to kill, Indians to trade with, and save them from enemies."

Among the Navajos, also, by the same authority, "The sun, moon and stars are sacred, as the authors of seasons of rain and of harvest." He also says of the Zuñians, "Beneath the apparent multiplicity of gods, these Indians have a firm faith in the Deity, the unseen Spirit of God. His name is above all things sacred, and like Jehovah of the Jews, too holy to be spoken. Montezuma is His son and their king. The sun, moon and stars are His works, worthy of their adoration."

The "ancient Pueblos" of the Pacific slope of the United States, whose ruined stone structures are found so numerously throughout portions of Colorado, Utah, New Mexico, Arizona, and probably Nevada, held the sun in high esteem, at least, if they did not worship it. This is shown in the situation of the houses in many localities. In the Cañon of the Rio Mancos,[2] for example, the dwellings are almost invariably found secreted in the cliffs of the *western* bluff, and from their roofs the inhabitants were wont to salute the king of day as he raised himself above the eastern plateau.

[1] Vol. III, Pacific R. R. Reports.

[2] A northern tributary of the Rio San Juan, in the extreme south-western corner of Colorado.

Among the Moqui tribe, to-day, traces of this form of worship still obtain. The religion of their forefathers seems to have degenerated into a mere custom, the origin of which has been long lost sight of in their obscure traditions. Thus, in the course of time, it seems probable, the worship of celestial orbs has given place to hero-worship; solar worship to anthropomorphism, and it is said that the Moquis have ultimately become imbued with the belief that it is a Messiah, in the form of one of their own ancestors, that is, Montezuma,[1] whom they are expecting to arrive from the east. The Moquis and the Pueblos and Zuñis are cognate tribes and doubtless remnants of the ancient Nahuatlac races; hence the similarity of their customs.

As the faint streak of red lights up the low horizon, tall, dark figures appear on the parapets of the seven Moqui towns and remain facing the dawn until the sun has appeared entirely to view. Then the muffled forms drop away slowly and sadly, one by one, for another morn has brought disappointment to the souls of many that have watched so eagerly and persistently for the coming of the great Montezuma. The routine of another Moqui day has commenced; all is bustle and life and the subdued hum of household occupation floats out drowsily on the sullen, sultry air and the sound of the hundred flour-mills (*metates*) grinding steadily on every side, seems, as it issues from the doors and windows of the stone houses, to pause in mid-air like a droning bee. Then scores of busy figures repair with their water-vessels to the verge of the steep bluffs, and disappear in the crevices of the rocks below.

Having presented these facts in support of the assumption that solar adoration entered, to some extent, into the religions of some of the American races, we may sum them up briefly as follows:

1. Fetichism being the commonest form of idolatry, especially amongst the lower races of man, most tribes whose religion is polytheistic, venerate the sun.

2. We can detect vestiges of sun-worship in the ruins of the Toltec and Aztec temples and pyramids and also in the statues which were placed within them.

3. We can observe traces of it in the traditions and observances of savage and semi-civilized tribes at the present day.

4. We notice indications of it in the hieroglyphics or picture-

[1] Motecuhzuma.

writings of most North American tribes, ancient and modern, in which the sun symbol occurs frequently.

5. Also in the position of ruined stone houses which look toward the east, the larger rectangular buildings of the Pacific slope being built so as to face the cardinal points.

6. Finally, we can observe signs of this worship in the orientation of dead bodies in graves.

If we accept these briefly stated facts, there can be no reasonable doubt that the worship of the sun entered, to some degree, into the religions of the American aborigines; how far, we have not the means of determining; yet, quoting the poet Southey's words,—

> "I marvel not, O sun! that unto thee
> In adoration man should bow the knee,
> And pour the prayer of mingled awe and love;
> For like a god thou art, and on thy way
> Of glory sheddest, with benignant ray,
> Beauty, and life, and joyance from above."

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A NEW LOCALITY FOR CORDYLOPHORA.

BY S. F. CLARKE.

THIS interesting form of compound hydroid was first discovered in this country by Prof. Leidy, a number of years ago. It was found living "in a slightly brackish pond near the coast," in the neighborhood of Newport, Rhode Island. In October, 1870, it was again taken by Prof. Leidy, this time in the Schuylkill river, near Philadelphia. A record of the same will be found in the Proceedings of the Academy of Natural Sciences, Philadelphia, for 1870, page 113, from which we learn that Prof. Leidy had not decided whether his specimens were distinct from *C. lacustris* Allman. He says "It appears however to be much smaller. Allman says the colonies are several inches and the polyps a line in length. Ours are not more than one-half that size. As a variety it might be named *C. americana*." Unfortunately there are no specimens to refer to and their specific identity must be left undetermined.

On the thirteenth of last October a collecting party of three from the John Hopkins University, consisting of Dr. Brooks, Dr. Uhler and the writer, were so fortunate as to find *Cordylophora lacustris* Allman, living in great abundance within seven or eight miles of Baltimore. The mouth of Curtis' creek, from the point

where it empties its cold clear spring waters into the Chesapeake bay, for a distance of one hundred and twenty yards up the stream, was densely populated with colonies of this beautiful organism. Attached to the water-plants (two species of Potamogeton and a Nitella), and to the rocks in the bed, and on the sides of the creek, they formed a delicate living fringe to every object in the stream. At the mouth of the creek its bed is about forty feet wide with a narrow channel on one side, in which the water, not over three or four feet in depth, flows very rapidly. In the channel where the sunlight is the strongest, owing to the much less abundant growth of vegetable life, where the current is most rapid, and nearest to the mouth, where the changes in the surrounding conditions must be greatest, there we found the colonies in their greatest luxuriance. The waters of the Chesapeake are only brackish in this northern part of the bay, and the tide rises and falls but ten or twelve inches; still this is sufficient to make quite an appreciable difference in the saltness, density and temperature of the water for a number of hundred yards up the stream. The variations in the conditions then must be considerable and the changes must be quite sudden, as they occur with the rise and fall of the tide. The nutritive hydranths too must be possessed of great activity and strength to enable them to catch and retain their food while the water is dashing by them at such a rapid rate. Another visit was made to the same locality in the last week in October, when we found the reproductive bodies of both sexes in great numbers. In these latter the reddish-brown branched spadix showed very distinctly in certain stages of development, ramifying through the opaque-white mass of the gonophore, and in later stages becoming resorbed. The specimens differ in no important respects from the figures and description of Allman. The color is usually a little brighter, being pinkish-red instead of reddish-brown; occasionally there are as many as eighteen or twenty tentacles, and occasionally the shallow annulations at the bases of the ultimate ramuli may be absent, but these all fall within the range of specific variation. Unlike Prof. Leidy's specimens, those from Curtis' creek agree in size with those of Prof. Allman. It is interesting to note that in one of the localities where Prof. Allman collected it, he found it associated with Potamogeton and Lemna, though not attached to them as many of our specimens were.

Cordylophora presents three special points of interest: 1. It

possesses a ramified spadix. 2. It is the only compound hydroid ever found in fresh water, and 3. The reproductive zoöids are developed in a chitinous cup, while the nutritive zoöids are not so developed or protected.

One of the nutritive hydranths showed, in a slight degree, the polystomatous condition which the zoöids of this species at times present; and which has been described and figured by Mr. Hugh Price, of Oxford, England.[1] Mr. Price's specimens were obtained from the Victoria docks, and the polystomatous hydranths were found only on certain colonies. Some of these hydranths possessed as many as five distinct mouths, each one of which was supplied with a series of tentacles; though separated throughout their entire length, they remain united at the base, thus forming a small closely united group from a single hydranth. As the different mouth-bearing parts were very small and without tentacles in some of Mr. Price's specimens, and others were intermediate in size, he is inclined to consider this a regular mode of increase in the hydranths of this species. The single specimen of this kind obtained by us possessed two mouth-bearing portions, each with a set of tentacles and united at the base. Unfortunately it was not preserved and I have been unable to find any others in a similar condition.

There is but one other species of Cordylophora and it may not be out of place to mention it. Kirchenpauer found specimens of a compound hydroid growing upon buoys at highest tide limits in the river Elbe. These he describes in a letter to Busk as a new species of Cordylophora, giving them the specific name of *albicola*. It differs from *C. lacustris* in forming smaller colonies, in having the branches annulated throughout, and the perisarc terminates abruptly.

Habitat.—Grand Canal docks, Dublin, Allman; Commercial and West Indian docks, London, Bowerbank and Allman; a freshwater cistern near London, Busk; Agricultural drains near Lyme Regis, Dr. Lowe; Canal near Ostend, Van Beneden; Schleswig, Semper; neighborhood of Stockholm, Sweden, Retzius; near Rostock, F. E. Schulze; Newport, Rhode Island, Leidy; Schuylkill river, near Philadelphia, Leidy; in basins in the Jardin des Plantes, Perrier; The Baltic, Möbius; Curtis' creek, near Baltimore, Md., S. F. Clarke.

[1] Quarterly Microscopical Journal, Vol. xxiv, New Series xvi, folio 23.

AMŒBA PROTEUS.

BY PROF. JOSEPH LEIDY.

A wonderful creature is the *Amœba*, one of the lowliest of the lowest class of animals, a mere speck of the thinnest jelly endowed with the usual attributes of all living things. Possessing an extensile and contractile power, it puts forth portions of its material in any direction; which portions act as temporary instruments of locomotion and prehension, and which again withdrawn, melt away in the common mass without leaving a trace of their previous existence.

The human body with its intricate mechanism and appliances is a theme of incessant wonder and admiration, but the *Amœba* in its simplicity of structure and capabilities may reasonably excite the same feelings. Though it has long been known, it has recently acquired new interest, from the discovery in higher animals of jelly-specks which in structure and endowments are undistinguishable from the free *Amœba* of stagnant waters. The white corpuscles of the blood travel through the tissues of our body as independent beings, just as the *Amœba* creeps in the mud of a pool, and so alike are they that the wandering corpuscles appear as if they were parasitic *Amœbæ*.

With such a creature as an *Amœba*, of the utmost simplicity, a globule when quiet; of the most variable and ever changing shape when moving, one would not anticipate the recognition of different kinds, of the character of the more fixed specific forms of higher animals. Nevertheless, we observe, *Amœbæ* varying greatly in size, in the general habitual shape they assume in motion, in the extent and usual form of the locomotive prolongations, and in some other points, ordinarily sufficient to render different kinds distinguishable from one another.

Many naturalists think that all varieties of *Amœbæ* are transitory phases of one and the same species, and this view is in some measure confirmed by the occurrence of intermediate or transitionary forms which make it impossible, in many cases, strictly to define the limits of more characteristic and striking forms such as we commonly find. The same reasoning, however, applies with more or less force to higher organic forms, and as with these, it is at least convenient to refer to the different kinds of *Amœbæ* as so many named species.

The first notice we have of the discovery of an *Amœba*, is by Rösel, in a work entitled "Insecten Belustigung," or Recreation among Insects, published in Nurnberg in 1755. Rösel calls the animal the little *Proteus*, and accompanies his description with colored figures engraved by himself.

Linnæus, in the Systema Naturæ, referring to Rösel's animal, named it *Volvox Chaos*, and afterwards *Chaos Protheus*. Nearly at the same time Pallas called it *Volvox Proteus*. Müller subsequently gave it the name of *Volvox Sphaerula*, but later, after having himself observed the animal, described and figured it under the name *Proteus diffluens*.

As the generic name of *Proteus* had been previously appropriated for the well known salamandroid of Adelsberg, Bory de St. Vincent substituted that of *Amiba* for the animal of Rösel and Müller, calling it by the various names of *Amiba divergens*, *A. Röseli* and *A. Mülleri*.

In 1830, Ehrenberg described a comparatively small *Amœba*, which together with all others previously noticed by different authors, he referred to the same species under the name of *Amœba diffluens*. In 1831, in the Transactions of the Academy of Sciences, of Berlin, p. 79, Ehrenberg described what he considered to be a new species of *Amœba* with the name of *A. princeps*. Its characters are as follows: "diameter 1-6th of a line; body transparent, yellowish, with many readily and voluntarily movable blunt processes, four times larger than the *Proteus*." In 1838, in his great work, the Infusionsthierchen, Ehrenberg described *Amœba princeps* as "large, yellowish, equaling 1-6th of a line, provided with a variable number of cylindrical appendages, thick and rounded at the end."

Accompanying the former description there is also one of *Amœba diffluens* as follows: "diameter 1-24th of a line, body clear as water, with mostly three or four variable processes; four times less than the former species." In the Infusionsthierchen the same is described as "branching, rarely extending or exceeding 1-24th of a line, colorless, with processes variable, moderately long, robust, and subacute."

From the descriptions it appears to me that Rösel's little *Proteus* accords with Ehrenberg's *Amœba princeps*, and not with *Amœba diffluens*. Ehrenberg says *A. princeps* is four times larger than the *Proteus*, meaning *A. diffluens*, and not the *Proteus* of Rösel, for

this as represented by Rösel is of greater size than that given by Ehrenberg to *A. princeps*. It would naturally be supposed that an *Amœba* discovered by the earliest observers, with instruments less perfect than those later in use, would be one of the larger and more common forms. That such was the case appears fairly proved by both figures and descriptions.

Rösel, referring to a figure of his little *Proteus*, remarks that in its natural size it looks like fig. A. Now this represents the animal in its quiescent state, in globular form, and the figure measures four-fifths of a line. No *Amœba* has since been recorded so large as this, and we may look upon the figure as somewhat exaggerated, which might readily have occurred without the accurate measuring instruments which came later into application to microscopic objects. Rösel also refers to his having held the *Proteus* at rest with the point of a feather, so that the evidence is sufficient to prove that the *Amœba* was one of the largest kind. Taking size alone into consideration, Rösel's *Proteus* is as far removed in one direction from Ehrenberg's *Amœba princeps*, as *Amœba diffluens* is in the opposite direction. But in other characters Rösel's *Proteus* agrees with the former closely, and not with the latter.

Ehrenberg describes *A. princeps* as yellowish, the *A. diffluens* as colorless. Rösel says nothing of the color of the *Proteus*, but his figures are colored yellowish. Most of Rösel's figures exhibit the characteristic changes of form of the animal in movement, and of one of these he remarks that in its branching it resembles the antlers of the deer.

As regards the concurrence of size and color of Rösel's *Proteus*, it might apply to other large *Amœbæ*, instead of *A. princeps*, as for instance the *A. villosa* of Wallich, or the *Pelomyxa palustris* of Greef, but the changes of form represented as occurring in the *Proteus* of Rösel, approach it rather to the former than to either of the latter.

Müller's descriptions and figures of *Proteus diffluens*, which that author regarded the same as Rösel's *Proteus*, likewise appear to apply to the same animal named *A. princeps* by Ehrenberg, rather than to that which he named *A. diffluens*.

If the views taken, as above expressed, are correct, it must be admitted that the *Amœba princeps* of Ehrenberg is the same animal as the *Proteus diffluens* of Müller and the little *Proteus* of

Rösel. Even consenting to the opinion that all forms of *Amœbæ* may eventually be shown to be transitory phases of the same species, it does not render the determinations of Ehrenberg and his followers, in regard to *A. princeps* and *A. diffluens*, any the less incorrect.

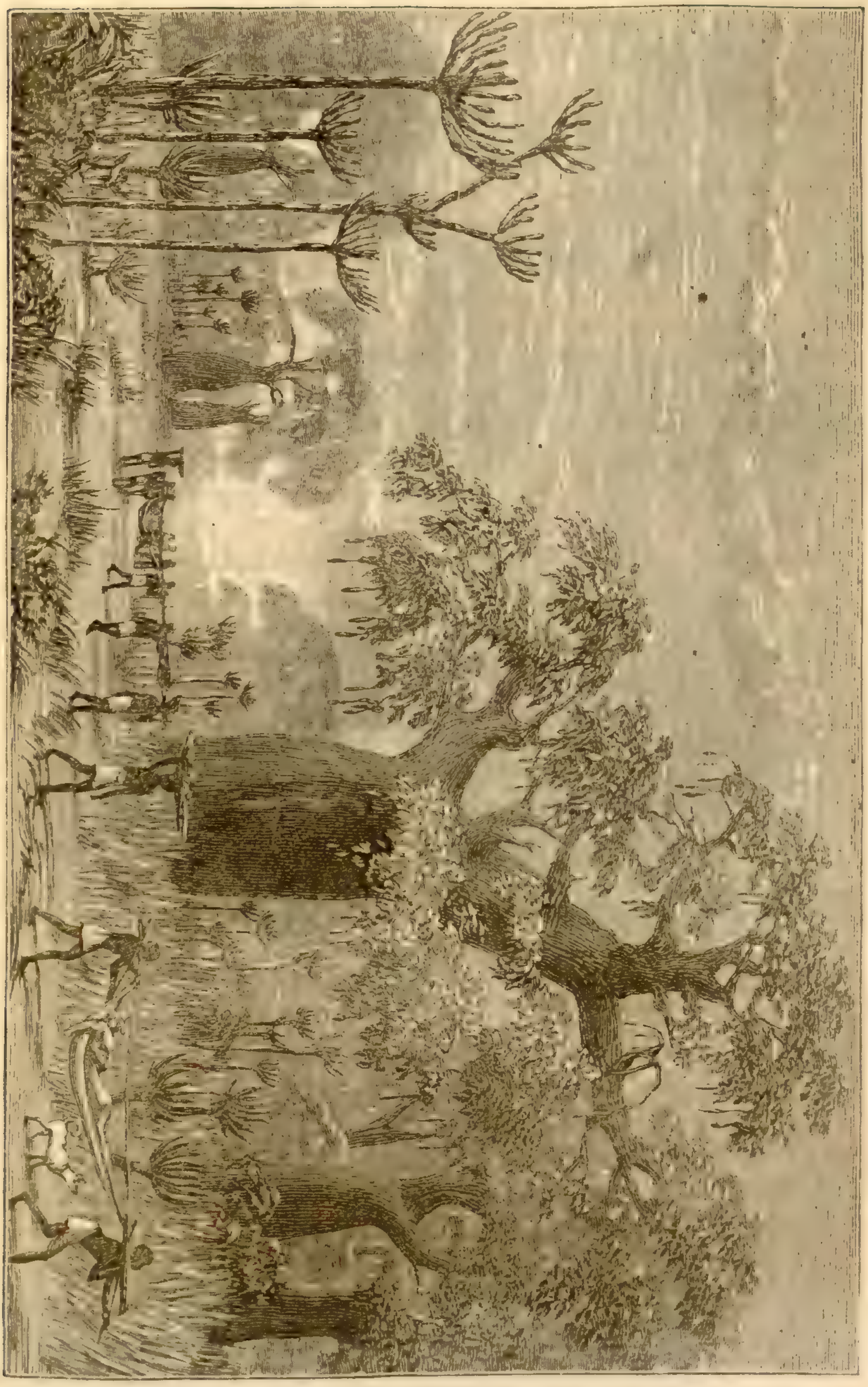
Arriving at the conclusion that the common large *Amœba*, usually assigned to *A. princeps* is the same as the *Proteus* of Rösel, the question arises as to its appropriate name. Of the specific names employed for the little *Proteus*, that of "*Chaos*" is the oldest, but appears to me less appropriate than that of "*Proteus*," applied afterwards. As the latter cannot be used in its generic sense, it might be accepted in its specific application so as to perpetuate the name given to the animal by Rösel, its discoverer. While, therefore, in strict conformity with the rules of zoölogical nomenclature, the little *Proteus* of Rösel, the *Proteus diffluens* of Müller, and the *Amœba princeps* of Ehrenberg, would be called *Amœba chaos*, I would suggest that it should be called *Amœba proteus*.

——:o:——

RECENT LITERATURE.

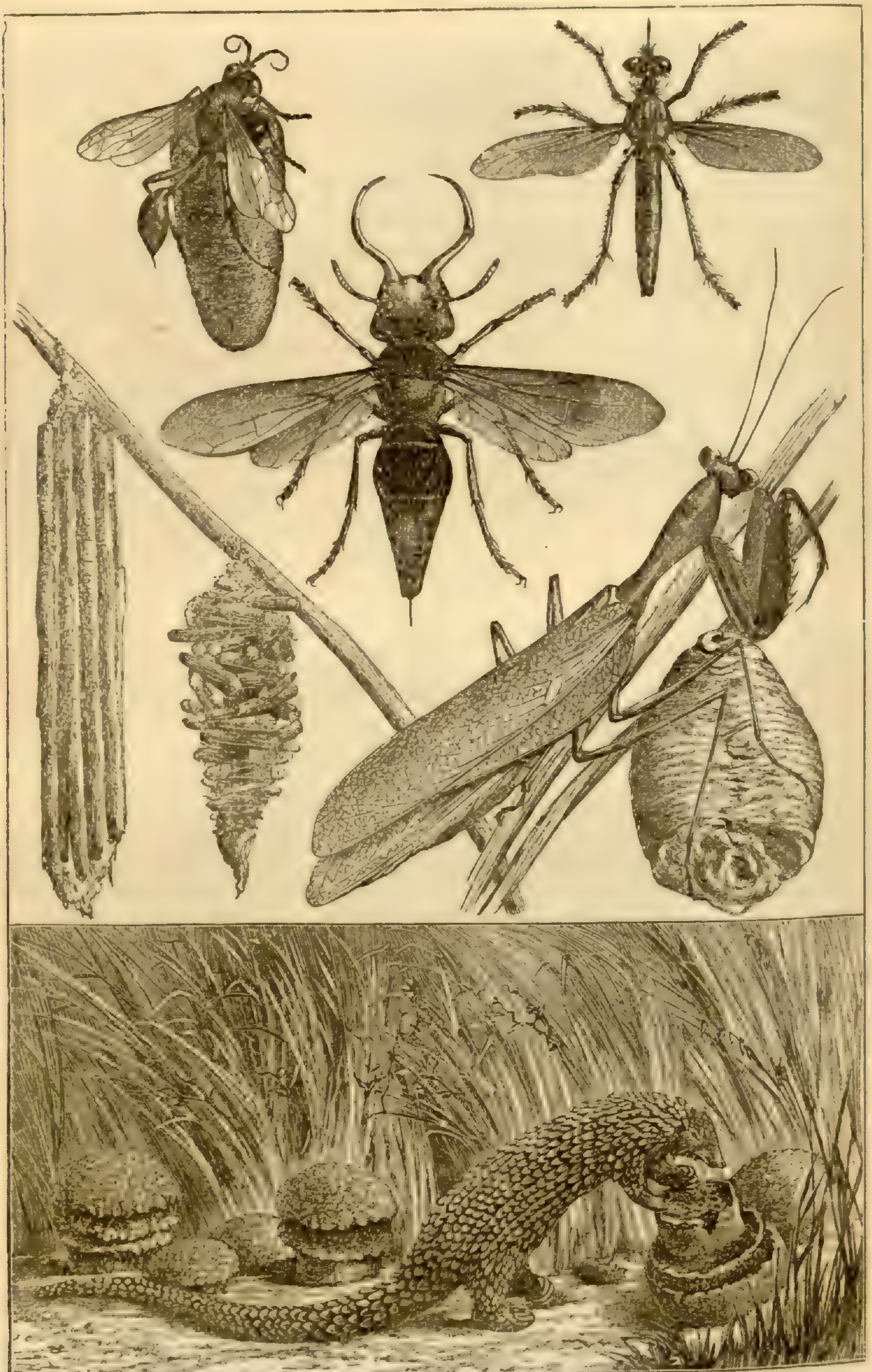
MONTEIRO'S ANGOLA AND THE RIVER CONGO.[1]—Now that Mr. Stanley has discovered the source of the Congo, and crossed the continent to the Coast of Angola, one will turn to the present book for the excellent account it gives of a region so little known. The country described by the author lies between the River Zaire or Congo and Mosammedes or Little Fish bay, comprising ten degrees of latitude. In this region, an interesting and rich part of tropical Africa, Mr. Monteiro lived and journeyed for many years. How the lowland country of the Angola coast may strike the stranger, and how the traveler journeys through its unique scenery, may be ascertained by a glance at the view here given. A number of similar full-page engravings adorn the book, which is full of interesting information regarding the country and its people, their manners and customs, and the effects of slavery upon them. All books of this sort sooner or later exhaust the human features of the country, and we are then regaled with interesting notes regarding the animals and plants, many of them so strange and striking. Some of the characteristic insects are rep-

[1] *Angola and the River Congo.* By JOACHIM JOHN MONTEIRO. With map and illustrations. New York. McMillan & Co. 1876. 12mo, pp. 354.



TRAVELLING IN ANGOLA—VIEW NEAR AMBRIZ.

resented in the accompanying cut, while the Manis, a type illus-



Pelopœus spirifex and nest.—Devil of the Road.—Dasylus sp.—Caterpillars' nests.—Mantis and nest.—Manis multiscutatum and Ants' nests.

trating the fauna of Southern Africa is seen in one of its characteristic attitudes.

The most wonderful natural product of this country is undoubt-

edly the *Welwitschia mirabilis*. Mr. Monteiro collected specimens of the plant, flowers and cones for Dr. Hooker, which supplied

WELWITSCHIAS GROWING IN A PLAIN NEAR MOSSAMEDES.

some of the material for his well-known monograph on this plant. Monteiro states that the country about the River San Nicolau, or 14° S. latitude, seems to be its northern limit. The

following account is extracted by the author from Dr. Hooker's work: "The Welwitschia is a woody plant, said to attain a century in duration, with an obconic trunk about two feet long, of which a few inches rise above the soil, presenting the appearance of a flat two-lobed, depressed mass, sometimes (according to Dr. Welwitsch) attaining fourteen feet in circumference (?), and looking like a round table. When full grown it is dark-brown, hard, and cracked over the whole surface (much like the burnt crust of a loaf of bread; the lower portion forms a stout tap-root, buried in the soil, and branching downwards at the end. From deep grooves in the circumference of the depressed mass two enormous leaves are given off, each six feet long when full grown, one corresponding to each lobe; these are quite flat, linear, very leathery, and split to the base into innumerable thongs that lie curling upon the surface of the soil. Its discoverer describes these same two leaves as being present from the earliest condition of the plant, and he assures me that they are in fact developed from the two cotyledons of the seed, and are persistent, being replaced by no others. From the circumference of the tabular mass, above but close to the insertion of the leaves, spring stout dichotomously branched cymes, nearly a foot high, bearing small erect scarlet cones, which eventually become oblong and attain the size of those of the common spruce-fir. The scales of the cones are very closely imbricated, and contain when young and still very small, solitary flowers, which in some cases are hermaphrodite (structurally but not functionally), in others female. The hermaphrodite flower consists of a perianth of four pieces, six monadelphous stamens with globose three-locular anthers, surrounding a central ovule, the integument of which is produced into a styliform sigmoid tube, terminated by a discoid apex. The female flower consists of a solitary erect ovule contained in a compressed utricular perianth. The mature cone is tetragonous, and contains a broadly-winged fruit in each scale."

Barrois' Embryology of Nemertean Worms[1].—The author of this work is well known for his labors on the developmental history of sponges. His aim in the present essay is to give as complete a history as possible of the normal development of a group of nemertean worms. These are low, in the adult state, non-segmented worms with a wonderfully extensile body, whose young are in some cases (though not in those mentioned by the author) related in form to those of the true Annelids, being segmented. M. Barrois concludes from a study of the development of a number of genera (*Lineus*, *Amphiporus*, *Tetrastemma*, *Polia*,

[1] *Mémoire sur l'Embryologie des Némertes.* Par M. Jules Barrois. (Annales des Sciences Naturelles, Sixtième Série. Tome vi. Paris, 1877.) 8°, pp. 232, with 12 plates.

Cephalothrix, *Drepanophorus*) that they pass through three principal stages.

I. A bilateral Gastrula-form.

II. A Gastrula, with the middle layer (mesoderm) arising from the exoderm, and composed of two principal rudiments: (1) the muscular layer, thin and uniform; (2) the recticulum, extending through the entire body-cavity, and represented in the embryos of *Lineus obscurus* by oil globules.

III. The longitudinal layer is enlarged in advance of the lateral organs into a solid mass; the nervous system arises over all the internal extent of the layer thus complicated. The internal cavity is divided into a system of cavities separated by partitions, all along which the reticulum is applied in a continuous layer.

These three states, which may be successively observed in the embryo of a nemertean worm, appear to exist in a more explicit way in Prorhynchus, where state II seems to be represented by an adult, free-living Planarian. The Nemerteans, then, appear to have derived from a sudden modification of the Planarian type, and justify, in the author's opinion, the establishment of homologies between the two groups.

Thomas' Noxious Insects of Illinois[1].—This interesting report is divided into two parts, the first relating to horticultural entomology, and the second comprising the introductions to and first part of a manual of economic entomology for the State of Illinois, including the Coleoptera. The first part contains excellent advice concerning the best means of contending against insects injurious to the orchard, especially general and preventive remedies, which are always the best and usually the last to be applied. Considerable attention is bestowed on the birds found to be useful in the orchard, and a list is given of the most important species. The report will prove very useful and timely to the farmers and gardeners of Illinois, for whose sole use it has been compiled.

Contributions to the Fossil Flora of the Western Territories. Part II. The Tertiary Flora. By L. Lesquereux.[2]—In this important work Prof. Lesquereux gives to the world the results of many years of laborious investigation of the remains of plants which have been discovered in the later horizons of the Rocky Mountain region from the Laramie formation upwards, by the U. S. Geological Survey under Dr. Hayden, and by Messrs. Berthoud, Le Conte, Denton and Allen, Profs. Lakes and Cope, Lieut. Vogdes and others. After considering the stratigraphy of

[1] *Sixth Report of the State Entomologist on the noxious and beneficial Insects of the State of Illinois.* The first biennial Report. By Cyrus Thomas, Ph.D., State Entomologist. Springfield, Ill., 18 7, 8°, pp. 174, iv, ii.

[2] *Report of the United States Geological Survey of the Territories.* F. V. Hayden, U. S. Geologist-in-charge. Vol. vii. 4to, pp. 366. 1878.

the lower lignitic formations of New Mexico, Colorado and Wyoming, which he with others regards as of undoubtedly cretaceous age, he proceeds to describe that of the true "lignitic," or as it will now be called, the Laramie formation. The descriptions refer chiefly to the exposures which the author has visited along the line of the Union Pacific railroad, and but little information is furnished respecting the strata of the Laramie on the middle and upper Missouri and the Saskatchewan regions. Then follow the detailed descriptions of three hundred and twenty-nine species of plants, many of which are represented by numerous remains, and from various localities. This portion of the work is illustrated by sixty-five plates, well executed by T. Sinclair & Son, of Philadelphia. Here the author supplies his fellow students with the most valuable evidence as to the characters presented by this vast department of life during the past periods of the existence of our continent.

The work closes by a general discussion of the meaning of the evidence with regard to the mutual relations in time of the various formations treated of, and their correspondences to the horizons of other countries. He reaffirms the conclusions previously stated, viz: that the floræ from the base of the Laramie upwards is of tertiary age. He divides the series into four groups, all of which (p. 352) he regards as belonging to the "Lignitic formation." He thus parallelizes them with the European standards (p. 354). "I admit the lower group as Lower Eocene; the second group, which seems intermediate between this and the Carbon, may be Upper Eocene; the relation of the third group is by its plants with Lower and Middle Miocene of Europe, and that of the fourth with the Upper [Miocene]. These are like the first outlines traced for the preparation of a map; they may be erased or modified, the spaces have to be filled as our acquaintance with the Tertiary becomes more intimate."

The evidence in favor of the correctness of these positions is rather more abundant than that derivable from the animal remains, and is handled with care in Prof. Lesquereux's discussion. There is no reason why his conclusions should not be accepted by students in other departments. Nevertheless the value of the evidence derivable from these vegetable remains is only to be fully understood by comparison with that derived from all other sources.

As a student for the last ten years of the vertebrate remains obtained from these formations, I have to say, as heretofore, that the evidence they offer as to the age of the horizons both in their mutual relations and their relations to the formations of other countries, is quite different from that presented by Prof. Lesquereux. It is well known that I was the first to show that the vertebrate fauna entombed in the lignitic formations to the summit of the Laramie, or to the summit of Prof. Lesquereux's first

division, and perhaps his second division, is of mesozoic and cretaceous type; and also that that of the Wasatch (or Green river) epoch, or Prof. Lesquereux's fourth group, lower division, is of Eocene Tertiary age. The evidence in favor of these positions has been steadily accumulating since I first announced them in 1869 and 1872, no exceptions have come under my notice, and their applicability has been extended to all parts of the North American continent which have yet been explored. In fact the most important interruption in the vertebrate life of North America is found between the Laramie and Wasatch epochs, and there only can the line between the Cretaceous and Tertiary periods of this continent be drawn.

The evidence in favor of this position has been in a measure overlooked by Prof. Lesquereux. He remarks (p. 30): "As no kind of cretaceous animal remains have been discovered in the Lignite of Colorado, none either in that of the north, generally called the Fort Union group, the question of age essentially bears upon that Bitter Creek series. The line of demarkation between the cretaceous and the tertiary is placed by Prof. Cope above the Black Buttes Saurian Bed." The facts as regards the amount of vertebrate evidence in favor of the cretaceous age of the Laramie, are as follows: In 1869 I determined the vertebrate remains from the Fort Union beds of Dakota, which had been supposed to be mammalian, to be reptilian, and indicative of the Mesozoic character of the Fort Union beds of the Missouri. The number of species furnished by this region is seven. In 1872 I obtained the *Agathaumas sylvestre* from the leaf-beds at Black Butte station in the coal region of Wyoming, and made the determination of its Dinosaurian character to which Prof. Lesquereux alludes. In 1872 I collected, in the Laramie formation of Colorado, nine species of vertebrates of the same genera, and sometimes species, as those previously determined from Dakota. In 1875 I determined the same genera and in some instances the same species from specimens sent by Dr. Dawson from the Saskatchewan. This collection included nine species. In 1876 I made an exploration of the Judith River basin in Montana, and obtained a large collection of vertebrate remains, embracing forty-eight species. These I showed to be of the same general character as the species already obtained from the localities previously mentioned, having a predominatingly cretaceous type, and close affinities and sometimes identity with those I had previously described. The vertebrate species now known from the Laramie formation are sixty-three, enough to determine clearly its position in the series; and study has shown it to be of uniform character over the entire continent north of New Mexico, and of general cretaceous type. Prof. Lesquereux seeks to explain the presence of the Dinosaurian *Agathaumas sylvestre* in a bed of Tertiary plants as did Prof.

See Bulletin U. S. Geological Survey Territories. III, No. 3, 1877.

Dawson, and has apparently not noticed my reply to the remarks of the latter gentleman. He observes (p. 351): "We may admit, however, that while the Tertiary age was at its beginning represented as a land formation as seen by its flora, a cretaceous marine fauna may have still locally persisted in deep seas. Facts of this kind are recorded in the European geology. The presence of the saurian *Agathaumas* in the lignite bed of Black Buttes is then certainly explainable as denoting the wandering of that animal out of its domain, and its death by penetrating into a peat bog and being irretrievably swallowed up by its soft matter."

Now it does not seem to be as well known as it should be that no such thing as a marine Dinosaurian has yet been discovered, and that the numerous *Vertebrata* of the Laramie formation are as generally terrestrial or, (in the case of the fishes) fresh-water in their character, as are the plants described in his valuable report now under review. I may here note the fact that Maj. J. W. Powell, who has followed Dr. Hayden in regarding the Wasatch epoch as of Tertiary age, was disposed at one time to place its inferior boundary below the *Agathaumas* bed, so excluding the latter from the cretaceous series. Last season's examination of the locality at Black Butte, by Prof. C. A. White, has convinced that gentleman that the boundary between the cretaceous and Tertiary formation is where I placed it, above the *Agathaumas* bed.

As regards the Lower Eocene character of the Wasatch beds, I have furnished abundant and conclusive evidence in various publications, which are summarized in the Vol. IV, of the Final quarto reports of Lt. Geo. M. Wheeler, published in 1877. This period witnessed the introduction of the Mammalian fauna in large numbers to North America, and forms the beginning of Tertiary time. Prof. Lesquereux's conclusion that it is of Miocene age, is negatived by the *Vertebrata*, which are typically lower Eocene. We must conclude then that not only was a Cretaceous fauna contemporary with a Tertiary flora in North America, but that the flora spans the greatest gap in the history of vetebrate life. We must also believe from the evidence offered by Prof. Lesquereux, that a Miocene flora was contemporaneous with an Eocene fauna. Since a Jurassic flora is still, according to Dr. Hector, existing in New Zealand, it must be evident that the positions of strata in the scale will be far more accurately determined by a consideration of the *Vertebrata*, than of any other form of life.—*E. D. Cope.*

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Sponges considered as a distinct sub-kingdom of animals. By A. Hyatt. (From the Proceedings of the Boston Society of Natural History, Vol. xix, Nov. 1, 1876.) 8vo, pp. 5.

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economic value of British Columbia, with a list of localities. By Geo. M. Dawson. (Reprinted from the Canadian Pacific Railway Report, 1877.) 8vo, pp. 47.

Geological Survey of New Jersey. Annual Report of the State Geologist for the year 1877. Trenton, N. J. By George H. Cook. 1877. 8vo, pp. 49. With a map.

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Collembola borealia — Nordiska Collembola, beskrifna af Tycho Tullberg. Öfversigt af Kongl. Vetenskaps akademiens Förhandlingar, 1876. No. 5. Stockholm. 8vo, pp. 20, 4 plates.

III. New Tineina from Texas. IV. Food-plants of Tineina. V. Index to the Described Tineina of the United States and Canada. By V. T. Chambers. (Extracted from the Bulletin of the U. S. Geological Survey, F. V. Hayden, in charge.) Washington. 1878. 8vo, pp. 88.

Catalogue of Phaenogamous and Vascular Plants of Jefferson county, Indiana. By Charles R. Barnes. To which is added a list of plants growing in Clark county. By John F. Baird. 8vo, pp. 9.

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On the first discovered Traces of Fossil Insects in the American Tertiaries, and on two new Carabidæ from the Interglacial Deposits of Scarboro' Heights, near Toronto, Canada. By S. H. Scudder. (Extracted from the Bulletin of the U. S. Geological Survey, F. V. Hayden, in charge, Washington, 1877.) 8vo, pp. 24.

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Mound-making Ants of the Alleghenies. By Rev. H. C. McCook. John A. Black, Philadelphia. 8vo, pp. 43, 5 plates.

On the Variation of the Decorticated Leaf Scars of certain Sigillariæ. By Herman L. Fairchild. (From the Annals of the New York Academy of Sciences, Vol. 1, No. 2.) 8vo, pp. 3, 2 plates.

On the Variations of the Leaf Scars of Lepidodendron aculeatum Sternberg. By Hermann L. Fairchild. (From the Annals of the New York Academy of Sciences, Vol. 1, No. 3.) 8vo, pp. 14, 5 plates.

A Synopsis of the North American Species of the genus Alpheus. By J. S. Kingsley. (Extracted from the Bulletin of the U. S. Geological Survey, Vol. iv., No. 1.) Washington, Feb. 5, 1878. 8vo, pp. 10.

On Notiothauma Reedi, a remarkable new genus and species of Neuroptera from Chili, pertaining to the family Panorpidæ. By R. McLachlan. (Extracted from the Transactions of the Entomological Society of London, 1877. Part iv, December.) 8vo, pp. 4.

Zur Physiologie und Histologie des Central nervensystem von Helix pomatia. Von Dr. Hermann von Ihering. Göttingen, 1876. 12mo, pp. 6.

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Ueber die Ontogenie von Cyclas und die Homologie der Keimblätter bei den Mollusken. Leipzig. 1876. 8vo, pp. 20.

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Ueber die Byssus des *Mytilus edulis*. Von Tycho Tullberg. Upsala. 1877. 1 plate, 4to, pp. 9.

GENERAL NOTES.

BOTANY.

CLEISTOGAMOUS FLOWERS IN DANTHONIA.—At the end of August last, Mr. Edwin Faxon and I, in the White Mountain Notch, collected a form of *Danthonia* which interested us much; although resembling *D. spicata* in its panicle, its culm was stouter than we had ever seen in this species, greatly swollen above the nodes, readily disarticulating as we sought to secure a supply (the plants being mostly out of season at that time), and showed in some specimens a panicle below the terminal one bursting from the upper sheath; the root-leaves as well as those of the culm were unusually large and long for *D. spicata*.

Mr. Chas. E. Faxon submitted his brother's specimens to Mr. C. F. Austin, who, though he thought the plant might be a form of *D. spicata*, described it under the provisional name of *D. Faxoni*, observing especially the unusually long and pointed teeth of the lower palet, and assuming that the culm of *D. spicata* is always single.

Not long since, on one of the mountains of Western Vermont, I came across specimens of *D. spicata*, which at once suggested to me the plants I had seen in the White Mountains, and tearing away their sheaths, I found concealed flowers in every specimen. Following up this clue to a solution of the puzzle presented by the White Mountain plant, I have since examined a large number of specimens of *Danthonia spicata*, and in every instance have detected flowers concealed in the sheaths, even the most depauperate plants with slender culms less than a foot in height showing at least rudiments of flowers.

Within the sheath on the side opposite its slit the culm is concave from the node upward, and the chamber thus formed is occupied by a spikelet one to ten-flowered, sessile on the node, and subtended by two awl-shaped, unequal, sometimes subequal, plumes, two to six lines long, and very rough on their back; or, in the case of the stouter plants, and in their upper sheaths, by two or more such spikelets, standing still sessile, side by side; or again, as in the case of the White Mountain specimens, by small panicles approaching in character the terminal one. In the smallest plants these spikelets are often undeveloped beyond a pair of short glumes; in all they are simplest toward the base of the culm; in the lower sheath of ordinary plants they are one-flowered; when several-flowered they are filiform, rather moniliform, the flowers being so distant on their rachis as barely to touch each other.

In the simplest state of the flowers, that is in the one-flowered, or few-flowered, spikelets near the base of medium-sized culms, their lower palet is smooth and shining, quite coriaceous, and, though tapering into an acuminate point, is entirely awnless. As

the spikelets become more highly developed, or are multiplied, toward the summit of the culm, particularly in the stouter specimens, the flowers generally approach in character those of the terminal panicle, their outer palets becoming by degrees thinner and rougher, and assuming an awn, at first short, straight, and terminal, then becoming more and more twisted, and placed lower and lower between the teeth of the notched apex. The glumes, also, are gradually modified, until as shown by the specimens from the White Mountain Notch, those of the upper spikelets in the panicle issuing from the sheath of the upper leaf are scarcely different from those of the terminal panicle. These hidden flowers are perfect, the palets of moss of those examined being found to enclose well-developed seeds. May they not be considered as a special means for the dissemination of this plant, which as a matter of fact is rapidly spreading over the drier soils of Vermont to the great detriment of agriculture, an ultimate scourge, completing the desolation begun by indiscriminate use of the axe, and helped on by the consequent increasing droughts of our summers? The seeds borne at the top of the culm of this grass fall readily for the most part in mid-summer; without aid in their dispersion, they must lodge in their immediate vicinity. But these concealed seeds securely stored within the sheath of the culms, when these are disjointed and swept away before the winds of autumn and winter, go to plant the species in new fields.

Danthonia compressa Austin, exhibits precisely the same cleistogamous flowers as *D. spicata*, and its culm disarticulates even more readily. In one of the few specimens of *D. sericea*, examined with this view, I find a one-flowered spikelet in its lower sheath; in this species, however, as it may be worth mentioning, the culms seem less stiff and not so easily separable at the joints.

In other genera of this family are these flowers to be found. I have already observed them in *Vilfa*, *Holcus*, and *Arrhenatherum*. —*C. G. Pringle.*

Ferns of North America[1].—In the present number plates are given of *Asplenium ebeneum* Aiton., *Asplenium ebenoides* Scott. Three species of *Botrychium*, namely, *B. lunaria* Sw., *B. lanceolatum* Ang., and *B. coreale* Milde, *Cheilanthes lanuginosa* Nutt, and *Cheilanthes californica* Mett. All of these except the last are described at considerable length. Prof. Eaton begins in each case with a concise diagnosis. This is followed by the synonymy and a list of localities, after which there is given in clear language a detailed description of typical specimens and of the troublesome varieties. The drawings by Mr. Emerton and the lithographic printing are well done. We must again express not only our pleasure at the excellence of the work, but our surprise at the remarkably low price at which it is furnished.—*G. L. G.*

[1] By Prof. Daniel C. Eaton. Part 2—Naturalists' Agency, Salem, Mass., $1.00.

A Fossil Fungus.—One of the most interesting recent discoveries in palæo-phytology has just been made by the English cryptogamist, Mr. Worthington Smith, in the detection, in the coal-measures, of a fossil fungus nearly allied to that which produces the potato-blight, and which he has named *Peronosporites antiquarius*. Fossil Fungi were not previously altogether unknown. Some years ago Mr. Carruthers, the keeper of the botanical department in the British Museum, detected mycelial threads among the cells of a fossil fern (*Osmunda*) from the Lower eocene strata of Herne bay; and Mr. Darwin has stated that fungus threads in a fossil state in silicified wood were shown to him more than forty years ago, by Mr. Robert Brown. Messrs. Hancock and Asthey have also described in the *Annals and Magazine of Natural History* (4th ser. vol. iv, 1869, p. 221, t. ix, x), under the name of *Archigaricon*, what may be a fossil *Peronosporites* from the Crawlington black shale. The specimen examined by Mr. Worthington Smith (the fungoid nature of the organism having been first suggested by M. Carruthers) was seen within the vascular axis of a *Lepidodendron*, and is thus described by that gentleman:—It consists of a mass of mycelia and zoosporangia (or oogonia). Beginning with mycelium, a close examination shows that it is furnished with numerous joints or septa. If, therefore, any reliance is to be placed upon the modern distinguishing characters of the now living species of the genera *Peronospora* and *Pythium*, as furnished by a septate or non-septate mycelium, the fossil parasite belongs to the former, and not to the latter genus, nor to any of the Saprolegineæ. The oogonia do not agree with those of *Cystopus*. Within many of the fossil oogonia the differentiation of the protoplasm into zoospores is clearly seen; but if any doubt could exist as to the exact nature of this differentiation, then other oogonia (or zoosporangia) on the same slide show the contained zoospores with a clearness not to be exceeded by any living specimens of the present time. It is a very remarkable fact that the oogonium precisely resembles, in size and other characters, average oogonia of the present day, especially those belonging to *Peronospora infestans*. The contained zoospores are, moreover, the same in form and dimensions with those of *P. infestans* when measured to the ten-thousandth of an inch. The organisms are in fact apparently identical; and the average number of zoospores in each oogonium is also the same, viz.: seven or eight. The aërial condition of the fungus has not been observed. Mr. Worthington Smith suggests, in conclusion, that we probably have in *Peronosporites antiquarius* one of the primordial plants from which both the great families of Fungi and Algæ may possibly have descended. There is no doubt that the Peronosporeæ and Saprolegineæ are very closely allied; and yet the former are commonly placed among Fungi, the latter among Algæ; and we may possibly here have the point of departure from which the two families branched out.—*A. W. Bennett.*

Botanical News.—The Transactions of the Academy of Science of St. Louis, Vol. iii, No. 4, 1878, contain the following botanical papers of interest, by Dr. George Engelmann: On the Oaks of the United States; The Flowering of *Agave shawii* (with a plate); The American Junipers of the section *Sabina* (with cuts); A Synopsis of American Firs (*Abies* Link); Oak and Grape Fungi.

Dr. Aug. Jæger continues his Genera et Species Muscorum, with reference to the mosses of the globe, in the Proceedings of the Natural History Society of St. Gall. The Proceedings of the Royal Danish Academy of Science contain an elaborate paper by Eugene Warming, on the development and morphology of the Cycads (with three plates). His studies were principally based on *Ceratozamia longifolia* and *brevifrons*, and also different species of *Zamia*, *Cycas* and *Dioon*. An important paper by Prof. E. Strasburger, on fructification and cell-division, appears in the Jena Zeitschrift, Bd. 11, Heft 4.

In the extraordinary volume of the Nova Acta of the Royal Society of Upsal, Prof. Fries describes the species of Swedish *Polybalstica*. The *Botanologia* of R. F. Fristedt is for the first time published. F. R. Kjellman discusses the algæ of the West Coast of Nowaja Semlja and Wajgatsch. Axel N. Lundström's critical remarks on the willows of Nowaja Semlja, and their genetic relations, is illustrated by an interesting plate, while Wittrock's elaborate paper on the development and systematic arrangement of the Pithophoraceæ, a new order of Algæ, will be of much interest to algologists.

Dr. Oscar Drude contributes a valuable paper to Petermann's *Mittheilungen* for January, on the geographical distribution of palms. The *Journal of Botany* for January contains a paper by A. Dickson on the structure of the pitcher of *Cephalotus follicularis;* the February number, Side-lights on the structure of Composites, and a note on the Dimorphism of Restiaceæ, by M. T. Masters.

The Bulletin of the Torrey Botanical Club for January, contains a valuable paper by G. E. Davenport, on Vernation in Botrychia, with a plate. In the Botanical Gazette for February, A. W. Chapman continues his enumeration of new Floridian plants.

ZOÖLOGY.[1]

Notes on the nesting habits of the English Sparrow.—Statements frequently come under my observation regarding the habit of this bird of appropriating the nests of other species for its own use. A prominent example of this kind came to view during the spring of 1875, at Reading, Penna. In 1874 I occupied a sleeping apartment, about eight or ten feet from the windows of which a pair of robins had constructed a nest in the

[1] The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

branches of a maple tree. The female had scarcely time to warm her abode before a lot of sparrows came and during the mélée the former was vanquished and driven away. The nest was then pulled up and partially destroyed. In the spring of 1875 a pair of robins came (and I doubt not but that they were the same), examined the débris which had been pretty well settled during the winter, and commenced the construction of another nest. This time they were unmolested until after the eggs had been deposited. I commenced to feel more secure for my little neighbors, but my gratification was of short duration. About a week had elapsed when the sparrows made another attack, finally conquering their opponents and driving them away. They tore the nest into one mass of rubbish, when all but one pair retired, which then worked an entrance and fitted it up, where they remained until two broods were hatched. In the spring of 1876 the limbs were sawed off of the trees, preventing probably a recurrence of similar exhibitions of strife, or in other words, downright cruelty.—*W. J. Hoffman, M.D.*

The largest of all fresh-water Polyzoa.[1]—There is in this neighborhood a fresh-water lake in which are produced curious jelly-like substances, covered on the outside with small seed-like bodies. These structures are of various sizes, from that of a cocoa-nut to that of a half-bushel basket, and are transparent for a thickness of two or three inches, the inside of the mass being tinged with red and green. They apparently begin their growth on a submerged stick or stone, and when grown large loosen and float about for a time, and then gradually dissolve or decay. The body of the jelly-mass is firm and cuts with a knife nearly as hard as a ripe melon.—*K. Cruger, West Chester Co., N.Y.*

Mr. Cruger apparently refers to the largest of all known fresh-water Polyzoa, *Pectinatella magnifica* Leidy.

Two New Genera of North American Fresh-Water Fishes have been recently described by Prof. D. S. Jordan, which are of considerable interest. One of them belongs to the family of the *Catostomidæ*, and is distinguished by a peculiar form of the mouth and lips, which approaches that seen in the Cyprinoid genus *Exoglossum*. The only species known is named *Lagochila lacera*, and is found in some of the tributaries of the Tennessee river. The other genus is Acanthopterygian, and is placed by Prof. Jordan between the *Percidæ* and *Aphredodiridæ*. It agrees with *Aphredoderus* in several particulars, but has a posterior vent. The typical species is quite small, and is found in the rivers of Arkansas and Texas. It is the *Elassoma zonatum* of Jordan.

A New Genus of Cystignathidæ from Texas has recently been determined by Prof. Cope from specimens discovered by G.

[1] Abstract of a letter communicated by the Smithsonian Institution.

W. Marnock, near San Antonio. It is allied to *Phyllobates*, being, like that genus, without vomerine teeth, but the nasal bones form a close continuous roof as in *Hylodes*. The species is of medium size, and is called by Cope *Syrrhophus marnockii*. With it were found specimens of the Eastern species of Hylid, *Chorophilus oculatus*.

Bassaris astuta in Oregon.—Mr. A. H. Wood, of Painted Post, New York, has lately sent to the Smithsonian, at my request, a specimen of *Bassaris astuta* taken in a trap, on Rogue river, thirty-five miles north-west of Jacksonville, *Oregon*, in December, 1877. The person who took it had hunted and trapped in the region for many years, but had never before seen such an animal. This occurrence is interesting as still further extending the known range of the species: see Baird, Mamm. N. A. 1857, 147 (Arkansas and California and south through Mexico); Sullivant, Am. Nat. vi. 1872, 362 (Ohio); Coues *ibid.* 364 (Ohio and Kansas).—*Elliott Coues, Washington, D. C.*

Leptodiscus medusoides, a new form of Noctiluca.—In the *Jenaische Zeitschrift*, Neue folge, 4th Band, 3d Heft, 1877, Richard Hertwig, under the above name, describes an exceedingly interesting Noctiluca-like organism which he had the good fortune to discover in the Harbor of Messina, during the winter of 1876–77. This new form is perfectly discoid in shape, with the flagellum characteristic of *Noctilucæ*. Its size varies, measured across the disc from 0.6 mm. to 1.5 mm. The disc is thickest in the centre, somewhat raised or convex on the dorsal side, while the ventral is concave; near the ventral surface and in the centre, there is a bipartite, ovoid nucleus, the smaller half of which is homogeneous, the larger, granular. Numerous oil globules are imbedded just beneath the dorsal integument, but with the exception of the whitish spot (granular area), in the centre the disc is clear and transparent, exhibiting slight iridescence of the convex side.

As the names indicates, this organism is medusa-like, but this likeness becomes still more strikingly manifest when the organism moves. As in *Medusæ*, change of place is effected by the powerful contraction and dilatation of the umbrella-shaped body, like the former forcing the water suddenly from the cup-like cavity. In the energy and rapidity of the contractions Dr. Hertwig says it is not behind any *Medusa*, provided the little creature is touched with a glass rod. Under these circumstances it darts like a *Rhopalonema* through the water as swiftly as an arrow, by the quickly succeeding pulsations or contractions of its umbrella-shaped body. The strongest contractions were produced by osmic acid, the creature under the action of this reagent becomes bell-shaped, about half as wide across the free border of the bell as it is high. As in *Medusæ*, the animal has the power of bending portions of the free border of the umbrella inwards, or sometimes the opposite

halves of the disc become bent towards each other like the opposite valves of a mollusc. Altogether the discovery is a most interesting one, showing as it does the wide range of form and physiological differentiation which may be exhibited by a very restricted group of simple organisms.

MARGARITANA DEHISCENS Say.—A study of the anatomical parts of various species of *Unionidæ*, leads to opinions somewhat different from those set forth by Mr. Lea in the last edition of his invaluable *Synopsis*, and suggests a revival of the discussion as to the propriety of dividing the genus Unio, as now constituted, into several genera or sub-genera. The soft parts of these molluscs have been found to present very great differences, not only in the position and relation of the various organs, but also in regard to their degrees of development.

The species known as the *Margaritana dehiscens* of Say, presents characters that set it entirely apart from the other species of that group examined in connection with it. These characters will be fully set forth in a future article, when further studies and observations shall have been made. It is suggested that this species belongs to the genus *Leptodea* of Rafinesque. It exhibits certain characters that would seem to ally it to the genus *Mycetopus* from South America.—*A. G. Weatherby.*

ON TEXAN STREPTOPOMATIDÆ.—The writer has recently had the pleasure, through the kind services of Mr. G. W. Marmock, of Bexar county, Texas, of examining specimens of the exceedingly rare *Melania pleuristriata* of Say, which, before Mr. Marmock's discovery, was regarded as a lost species, no types being in existence.

A careful study of the linguals of this species, as well as various characters of the shell, and the extreme south-western geographical range, suggests its close alliance to the genus *Pachycheilus* Lea.

I am informed by Mr. Marmock that it inhabits the springs of south-western Texas, in this respect having the habit of the East Tennessee *Goniobasis*. A species closely allied, or a very persistent variety, for which I suggest the name, at present, of variety *marmocki*, accompanies the specimens, together with an unidentified *Planorbis*, a *Physa* and a *Lymnæa*.

Mr. Marmock also found, in the same region, the very rare *Holospira roemeri* Pfr., the *Macroceramus pontificus* Gould, and the *Helix photus* Pfr.

The description of the *Pachycheilus* was published by Mr. Say in the New Harmony Disseminator, December 30, 1839. Descriptions may also be seen in the following works: Descr. of New Shells, 8vo, p. 15, 1840; Binney's Edition of Say, p. 140.

For the identification of the species, and the above references to the description, the writer is indebted to the kindness of Mr. Geo. W. Tryon, Jr.—*A. G. Weatherby.*

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—In the *Geographical Magazine*, for February, will be found an interesting autobiography of Hans Hendrik, an Eskimo, who served with Kane, Hayes, Hall, and Sir George Nares, translated by Dr. Rink.

Dr. Hoffman, Assistant Surgeon U. S. A., communicates the following description of a practice among the Dakotas, of Grand river, D. T., for producing abortion: The hair from the tail of the black-tailed deer is cut up into short pieces and fried in the fat of black bears' paws. The patient swallows as much of this as is thought necessary to produce the effect. There are certain old squaws who are recognized as "general assistants," and nurses to lying-in women, and they are frequently called in to aid young and old women in producing abortion. The patient sits upon the lap of the nurse, who reaching around the abdomen and interlacing her fingers to get a secure hold, hugs her victim with all her strength repeatedly and for a long time. This frequently ends to the satisfaction of the operator and subject.

Mr. Paul Schumacher, writing from San Francisco, makes the following communication with reference to the perforated stone discs found so abundantly in Southern California and elsewhere: "With reference to the employment of these objects to give weight to digging-sticks, I received my information from a half-breed Indian who had seen, in his youth, the last aboriginal inhabitants of the Island of Santa Cruz, still occupying the *rancheria* at Prisoners' Harbor, in which I made excavations for the Smithsonian Institution three years ago. I have since followed up the subject, and although positive proof is wanting, no contradictory evidence was observed during my researches. The aborigines cultivated extensively on some of the islands, a species of plant, on the bulbs of which they partly subsisted, and they even exchanged them with the people of the main land. I did not say that the design of the digging-stick was to open graves, as the handy Haliotis shell was better adapted to this purpose in the sandy ground of the islands in which the graves are located. The fact that some of the rings are of light weight is no argument against my position, as digging-sticks are used without weight, by the Australians of our day. There is hardly a class of relics that is not frequently represented by diminutive specimens, rougher and less symmetrical than the full-sized (they may have been playthings for children); but these should not deter the student from correctly naming the average sized objects." Mr. Bowers says, "Those of pyramidal form were doubtless used for spinning, while the others [simply a variety in form, but alike in perforation] were used in games." How were these used for games, and those for spinning? I have summed up the evidence for their use as weights to digging-sticks in a paper, entitled "Aboriginal

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

Manufacture," now in the hands of the Curator of the Peabody Museum.

The second part of Anales del Museo Nacional de Mexico contains the following anthropological papers: Cuestion Historica, Sr. D. Jesús Sanchez; Dedicacion del templo major de México, Sr. D. Manuel Orozcoy Berra; Estudio comparativo entre el Sanscrito y el Naguatl, Sr. G. Mendoza, director del Museo; Idolo Azteca de tépo japones.

The Smithsonian Institution has long had the intention of publishing an exhaustive work upon North American archæology, accompanied by maps, exhibiting by signs and colors the site and character of all archæological remains. To this end a circular has been issued and the Institution calls upon all lovers of American antiquities to lend a helping hand, which the readers of the NATURALIST, doubtless, will not be backward in doing.

FOREIGN.—The following papers have come to our notice since our last issue: Gaul and its History under the Romans, by Professor Friedlander, in *Deutsche Rundschau*, for December; Mythology among the Hebrews, Ignaz Goldzieher, reviewed in *Nature*, January 3d; The Second Harvest in Olympia, Profe-sor Ernst Curtius, *International Review*, February; Das Problem über den Ursprung der Sprache, O. Caspari, in *Ausland*, 1877, Nos. 47, 48, 49; Der Mensch, vormals und heute, Richard Oberländer, Otto Spämer, Leipsic, 1878; La Question de l' Homme Tertiaire, L'Abbé Bourgeois, Louvain, Peeters, 1877; Grammar and Dictionary of Samoan, Rev. G. Pratt, London, edited by S. J. Whitmee; *The China Review*, or Notes and Queries on the Far East, bi-monthly, Trübner & Co.; Transactions of the Philological Society of London, 1877–8–9, Part I, 800 pp.; Ueber die Methoden zur Ermittlung der topographischen Beziehungen zwischen Hirnoberfläche und Schädel, A. Ecker, in *Archiv für Anthropologie*, 1877, III.; Die Grosshirnwindungen des Menschen und deren Beziehungen zum Schädeldach, von Dr. I. Hefftler, id; zur Archäologie des Balticum und Russlands, von A. Grewinck, id; Les Allees Couvertes de la Provence, P. Cazalis de Fondouce, *Matériaux*, 10; Transactions of the Asiatic Society of Japan, V, Part I, October 1876–1877; Transactions of the New Zealand Institute, Index of Vols. I–VIII, by James Hector, Wellington; The Physical Basis of Mind, *Mind*, January; Fetichism in Animals, Geo. J. Romanes, *Nature;* "The Land of Cold, M. Nevirovich-Danchenko, St. Petersburg; Assyriology, *London Quarterly*, January; The Languages of India, Robert Cust, *Geographical Magazine*, January, finely illustrated; An Account of the Polynesian Race: its Origin and Migrations, and the Ancient History of the Hawaiians, Abraham Fornander, Vol. I, Trübner; The Dawn of History; An Introduction to Pre-historic Study, C. F. Keary, London, Mozley & Smith; Archæology in Italy, Felice Barnabei, *Academy*, January 12.—OTIS T. MASON, Washington, D. C.

GEOLOGY AND PALÆONTOLOGY.

A PROBLEMATICAL FOSSIL from the Cretaceous of Bohemia is described by Dr. Anton Fric in his volume on this formation in the Archiv der Naturw. Landesdurchforschung von Böhmen, under the name of *Lepidenteron longissimum.* It is quite abundant, and resembles a cast of a worm-boring, or of an elongate alimentary canal of a fish. It is covered with scales and bones belonging to different species of fishes, and Dr. Fric suggests that it is the cast of a tube of some worm, which covered its abode with those objects, as the larvæ of *Phryganeidæ* use mineral and vegetable fragments at the present time.

THE PLASTIC CLAYS OF NEW JERSEY receive a full exposition from Prof. Cook in the last report of the Geological Survey of that State (1878), so far at least as regards those of cretaceous age. He states the view of Lesquereux that they represent the Dakota epoch of the west, and offers some pertinent remarks as to their probable origin. He believes that they were derived from the decomposition of feldspars contained in the granite and gneiss of a former extension of the azoic beds now visible to the north-east and south-west in the high grounds of the cities of New York and Philadelphia. This exposure Prof. Cook believes to have formed a barrier to the eastward of the present beds of cretaceous age, and to have at times excluded the salt-water from the enclosed lagoon. This hypothesis was, we believe, first proposed by Prof. Cope in explanation of some characteristics of the cretaceous formations of New Jersey. Additional evidence in favor of the derivation of the material from the south-east is seen by Prof. Cook in the absence from the clays of all traces of the material of the Triassic formation which bounds it on the north-west at the present time.

PLIOCENE VERTEBRATA OF THE VAL D'ARNO.—Dr. C. I. Forsyth Major, in the Atti. Soc. Toscana d. Sc. Nat., describes two species of *Canis* from the upper val d'Arno and val d'Era, which he regards as new, and names *Canis etruscus* and *C. falconeri.* The former is as large as the wolf; the latter rather larger. Mr. Major gives the following list of species of the pliocene of the upper val d'Arno; *Macacus* 2 sp., *Felis* 3 sp., *Canis* 2 sp., *Ursus* 1 sp., *Mustela* sp., *Hyæna* 2 sp., *Machærodus* 3 sp., *Equus* 1 sp., *Hippopotamus* 1 sp., *Mastodon arvernensis, Elephas* 1 sp., *Rhinoceros* 1 sp., *Sus* 1 sp., *Bos* 1 sp., *Cervus* 4 sp., *Castor* 1 sp., *Hystrix* sp., *Lepus* sp.

SURFACE GEOLOGY OF BRITISH COLUMBIA.—We have received from Mr. G. M. Dawson of the Canadian Geological Survey, a letter upon this subject, calling our attention to what had been printed by himself on the Geology of Vancouver Island, of which we had not known when our article was published in the NATURALIST for November, 1877.

"I have just read your interesting notes on the glaciation of

the Pacific coast, in the November number of the AMERICAN NATURALIST. I traversed the same region on my way to Victoria last spring, and hope shortly to publish in the Canadian Naturalist a few memoranda made at the time. As you will see by the abstract of a paper of mine, read before the Geological Society last June (posted with this), I believe it can be shown that the glaciation of the south-eastern part of Vancouver Island was not accomplished by the glaciers of the interior of the island, as such, but by a great glacier sheet filling the Strait of Georgia, which though receiving tribute from the mountains, was fed chiefly by the accumulations on the coast range of the mainland, and perhaps through its gaps by ice from the central plateau of the country. I hope soon to be able to send to you a printed copy of the paper referred to, which will make the points on which this supposition is based, clear. The north to south glaciation of the interior of the province, mentioned in the abstract, I have been able to confirm during this season's exploration, in a number of additional localities, and have even found it furrowing the summit of an almost isolated mountain at an elevation of over 5000 feet.

"The original discovery of marine shells in the drift of Vancouver Island is due to Mr. H. Bauerman. You will find the matter mentioned in the Quart. Journ. Geol. Society, 1859, p. 198; also in Dr. Hector's Report of Explorations in the North-west; see also Mr. Dawson's article in the Canadian *Naturalist*: 'Note on some of the more recent changes in Level of the coast of British Columbia and adjacent Regions.'"

MICROSCOPY.[1]

NEW METHOD OF OPAQUE MOUNTING.—Mr. C. C. Merriman of Rochester, in a recent communication to the microscopical section of the Troy Scientific Association, describes the method of preparing his elegant preparations of foraminifera which have attracted unusual attention and admiration in the Postal Club, at the soirée of the Troy Association, and indeed wherever they have appeared. A cell is first made of a brass curtain ring slightly flattened by a hammer and suitably cemented to a slide. A cover glass, of size to match, is then varnished on one side with a thin solution of balsam, and upon this coating, when sufficiently hard, the shells are arranged in the usual manner; the whole group is then varnished over with successive coats of the balsam solution until completely imbedded in it; coats of asphalt varnish are then added until a perfect black-ground is obtained. The success of these procedures depends almost wholly upon using the solutions in a thin state, and allowing one to dry thoroughly before another is added. When all is dry and hard, the cover, with its objects mounted on it, is inverted on the cell

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

and attached by any strong varnish, and the joint finished off with white zinc cement. The objects appear with great distinctness, lying with their upper surfaces on a level and close to the cover glass, but looking as if they were at the bottom of a dark, deep cell. This method is also applicable to many of those objects which show well as opaque objects when immersed in balsam.

IMAGES IN THE EYES AFTER SUDDEN DEATH.—Mr. Henry C. Hyde, the newly elected president of the San Francisco Microscopical Society, in his opening address, gave a very interesting summary of the recent remarkable discoveries of Profs. Böll, of Rome, and Kühne, of Heidelberg, in the anatomy and physiology of the eye. He said that the popular notion that the *murderer's image* is found photographed as it were on the retina of his victim's eye may have some foundation in fact, viewed in the light of these recent discoveries, especially those of Dr. Kühne. Histologists have always considered the rods and cones of the retina, which are taken to be the terminal organs of the optic nerve, to be in a natural condition when under examination. Prof. Böll found, however, that when the animal, say a frog, is killed rapidly and the retina viewed as quickly as possible, it has peculiarities never before observed, and throwing new light on the physiology of vision.

Since the experiments of Dr. Kühne are more elaborate and extensive than those of Prof. Böll, a sketch of them will be most instructive. Prof. Boll found that the newly removed retina had a rosy purple tint, which was difficult to examine, because exposure to light changed it in ten seconds to a satiny lustre, and then after fifteen minutes of transparency to a turbid opacity. Dr. Kühne discovered that if kept in the dark, or in sodium (yellow) light, the delicate "vision purple" of the removed retina could be retained as long as wished, thus making a series of very original and incisive experiments possible. It is proved that the retina contains a substance which, under the influence of light, undergoes a chemical change varying in intensity with the intensity and character of the luminous rays. In the living retina there is some process which restores to this substance its responsiveness to light as fast as it loses it by the action of light—a continual recharging with powder, as it were, of the retinal batteries which the impact of light waves is continually firing whilst vision continues. But after death, or removal of the retina, the gunner—the faithful heart with its supply of nutrient blood—having ceased his work, the last charge is fired and the batteries stand emptied. So, the light waves remove the color from the isolated retina in a few moments, unless they be shut out by darkness, then the retina can be kept in its natural condition, purple colored, the batteries ready charged to signal to the brain

by their discharge the impact of the first light wave. Having thus the power of keeping retinæ just as they leave the eye, by immersing them in darkness, or yellow light, very much as the photographer takes his negative from the camera and preserves and finally *fixes* the image, working at it always by yellow gas-light, Kühne also preserved the images that were in the natural photographic plate, the retina of the natural camera, the eye, and actually *fixed* these images by soaking them in a solution of alum. Thus he would fix the head and one of the eye-balls of a living rabbit opposite a bright skylight, cover it with a black cloth for five minutes, then remove the cloth, exposing the eye a few minutes, immediately remove the eye, soak in alum, and, upon examining the retina, find a beautifully accurate image of the skylight, showing its separate parts, the boards, etc. Even the eye in a severed head gave these results. The images were generally of a rosy hue.

Now, while this proves that images of objects seen before death may be found on the retina after death, yet, since to make this possible, the eye and the object must be perfectly still for some minutes, and the light must be strong, it probably never has happened, and never will happen that the image of the murderer is found in the eye of his victim, murder being a deed of darkness, and a deed tending to anything but immovableness in those enacting it.

Annual Elections in Microscopical Societies.—The following officers of societies have been elected since those last published:

Jamestown Microscopical Club. Organized June, 1873. Meets first Thursday evening of each month. Dr. A. Waterhouse, president; Chas. E. Fuller, secretary and treasurer.

Louisville Microscopical Society. Founded January, 1874. Meets first and third Thursdays of each month at Louisville Library. Dr. J. B. Marvin, president; Dr. J. Sloan and Prof. W. F. Beach, vice-presidents; D. W. Lane, secretary; J. Williamson, corresponding secretary; A. L. McDonald, treasurer.

San Francisco Microscopical Society. Henry C. Hyde, president; C. Mason Kinne, vice-president; X. Y. Clark, recording secretary; C. W. Banks, corresponding secretary; J. A. Langstroth, treasurer.

Buffalo Microscopical Club. Dr. L. Howe, president; Jas. W. Ward, secretary; Henry Mills, D. S. Kellicott and Geo. E. Fell, advisory council.

Laboratory work at the seaside.—The third session of the Summer School of Biology will be opened at the Museum of the Peabody Academy of Science, Salem, Mass., beginning July 5th and continuing six weeks. Lectures will be given five days of each week, and the best of opportunities afforded for laboratory

work with the microscope. In addition to the regular instruction in zoölogy by Dr. A. S. Packard and Messrs. C. S. Minot, J. H. Emerton and J. S. Kingsley, a series of afternoon lectures on microscopy will be given by Rev. E. C. Bolles. Admission fee, $20.00; board, $5.00 to $7.00 per week.

Besides this tempting arrangement, a marine zoölogical laboratory will be opened June 1st, on the outer shore of Salem Neck, under the care of Messrs. Emerton and Minot, in a position most favorable for the study and collection of marine plants and animals. The cost will be $20.00 per month, and students can conveniently attend the Summer School of Biology at Salem.

Soirées.—The annual meeting of the Buffalo Microscopical Club, at Goodrich Hall in that city, terminated in a soirée and exhibition of microscopic objects. A large variety of popular and interesting objects were shown under nearly twenty microscopes, to the universal gratification of the large audience. Dr. Geo. E. Blackham, of Dunkirk, and Chas. E. Fuller, of Jamestown, assisted the local members in the entertainment of the evening.

The microscopical section of the Troy Scientific Association and a large party of invited guests were entertained at the residence of the chairman of the section, Dr. R. H. Ward, on the occasion of the annual soirée on the evening of March 4th. The microscopes, over thirty in number and many of them first-class instruments, were arranged on tables in different parts of the house, and the objects were classified in a strictly natural manner, each table with its group of instruments being used to illustrate some one field in the study of nature. By substituting this plan for the want of method which is generally allowed to result from the caprice of individual exhibitors, and the use of a systematically arranged catalogue, and of cards stating the objects shown and the magnifying powers used, the exhibition was carried on promptly notwithstanding the large crowd in attendance. The soirée was the largest and most enthusiastic meeting ever held by the section.

Exchanges.—Wanted, some well-posted diatomist to give the correct names of diatoms (arranged) on a few slides in exchange for the slides. C. M. Vorce, 164 Lake street, Cleveland, Ohio.

——:o:——

SCIENTIFIC NEWS.

— A paper has been recently published in the *Penn Monthly Magazine* by William Blasius of Philadelphia, in which he criticizes the methods of meteorological investigation usually adopted. He, however, commends those employed by Prof. Loomis, of Yale College, but asserts that they have been mostly derived from his own previously issued publications.

— Recent arrivals at the Philadelphia Zoölogical Gardens, Feb. 10, 1878: 2 Chinese or knobbed geese (*Anser cygnoides*), presented; 2 common marmosets (*Hapale jacchus*), 1 black-eared marmoset (*Hapale penicillata*), presented; 2 barn owls (*Strix flammea*, var. *americana*) presented; 3 opossums (*Didelphys virginiana*), presented; 1 red-shouldered buzzard (*Buteo lineatus*), presented; 1 eland (*Oreas canna*) ♀, purchased; 1 siren (*Siren lacertina*), presented; 1 red-shouldered hawk (*Buteo lineatus*), presented; 1 bald eagle (*Haliaëtus leucocephalus*) presented; 2 rough-legged buzzards (*Archibuteo lagopus*), purchased; 3 white rabbits (*Lepus cuniculus*), presented; 4 hybrid fowls, presented; 8 dingos (*Canis dingo*), born in the Garden.—*Arthur E. Brown, Gard. Supt.*

— The Proceedings of the National Academy of Sciences, Vol. I, 1877, contains Selections from the Records of the Home Secretary, Prof. J. E. Hilgard, under whose direction this volume has been published. Unfortunately Congress has not yet authorized the publication of the papers and memoirs presented by the members at the semi-annual meetings of the Academy.

The Biographical Memoirs of the deceased members of the National Academy of Sciences has been published by the Home Secretary, and forms a volume of 343 pages. It contains obituary notices of fifteen deceased members.

— We have received, from Mr. Townend Glover, Manuscript Notes from my Journal, or Entomological Index to name, etc., in Agricultural Reports, with List of Vegetable and Animal Substances injured or destroyed by Insects, etc., Washington, 1877. This is a quarto work of 103 pages in the author's clear and legible handwriting transferred to and printed on stone. It forms a useful supplement to the laborious works of the author on the Diptera and Hemiptera, printed for private distribution.

— A new curriculum of education having been adopted by the board of control of public schools of Philadelphia, which includes a space in each of the divisions throughout the course, to be devoted to object study, the question of the introduction of primary instruction in the natural sciences is being agitated. At the last teachers' institute of the city, held in the Girls' Normal School, a lecture was delivered by Prof. Cope, in advocacy of this measure. In this lecture Prof. Cope explained that teaching in this department should never be without natural objects, models or charts. For general or comparative study, where the student should use a considerable number of objects, it was pointed out that petrology, mineralogy, botany, and entomology present the greatest facilities, since specimens can be obtained in these departments with the greatest ease. In the majority of departments of geology and biology it was maintained by the lecturer, that charts giving simple analyses of structure should be used, and it was recommended that these be of two kinds. Those of the first kind

were to stand in place of the text-book in other departments, to be of smaller size, and to be accompanied by pages of explanations, constituting an atlas to be studied by the scholar. The other kind should be of large size and be used in the school room like wall-maps without printed explanation. The exercises should be tests of proficiency of the student in the identification of parts in the specimens or the wall-maps, after study of the atlas or the object, under direction of the teacher. Instruction in classification following identifications of parts, were recommended to be conducted by the aid of simple analytical keys, either drawn by the teacher on the blackboard, or in chart form, like the diagrams of structure, suspended on the wall. The similarity between instruction in geology and structural biology, to geography was commented on, and systematic science was regarded as standing among the first of the methods of training of the human mind in all questions of practice or thought. In the dynamical sciences, or structure in motion, the use of text-books was regarded as necessary.

— The following circular has been issued by the Pennsylvania Board of Agriculture, and is signed by Thos. J. Edge, Secretary. As an effort to obtain reliable information on an obscure subject, by a goverment commission, it is worthy of general attention from those to whom it is addressed:

"Harrisburg, February 1, 1878. Dear Sir:—The report of this Board for your district has named you as a practical dairyman, who would be likely to take an interest in the advancement of our knowledge of dairy matters, and who would also be willing to answer any question which may be asked, with a view of obtaining such information. If our reporter is right in his surmise, and you are willing thus to assist me, you will please signify the same on the enclosed card; giving *full name and address, with number of cows in your dairy*, and return the card at your earliest convenience. This Department is aware that we have enough of theory, and are much in need of practical observation, and we think that by proper application of this kind of observation, you can enable us to render comparatively certain many items which are now in doubt.

"Of such subjects, we have selected the possibility of regulating the sex of calves as the first to claim your attention, and I would respectfully ask your careful and practical observation of the following theory, for one year, and would further ask that you report when you have any information to warrant you in so doing, giving the cases in which the theory has held good, as well as those in which it has failed. You can also confer a favor by directing the attention of your farm club or grange to the matter, and also interest any other dairyman in your neighborhood.

"It has been claimed by good authority, and the claim seems to be supported by proof, in some cases at least, that each alternate ovum will produce a male if impregnated at the proper

period: That is, if a cow has just produced a male calf, and is served at the next period of heat, a heifer will be the result; thus each ovum producing alternately male and female. If, as is often the case, your male is kept separate from the cows, you will have superior advantages for observation, and your results will prove of value in determining the question.

"Each one who will thus assist, and gives notice of his desire to do so by enclosed card, will receive a copy of the total result, and will also be entitled to the thanks of the Department."

— An account and figure of a two headed gopher snake (*Pityophis* species), by Mr. J. W. A. Wright, appears in the *Mining and Scientific Press*, San Francisco, February 16, 1878. A similar monstrosity in an eastern species, the common striped snake, we believe, was described by the late Professor Wyman, in the Proceedings of the Boston Society of Natural History for January 21, 1863 (vol. ix).

— The German botanist, Regel, has discovered, according to *Nature*, in the Himalayas a variety of wild onion, which he regards as the original source of our ordinary garden onion. It is called *Allium cepa sylvestre.*

— The well-known Danish conchologist, Dr. A. L. Mörch, died in January last at Nice. The eminent Swedish botanist, Prof. Elian Fries, died at Upsala, February 8, in his 84th year.

— Drs. W. Marshall and A. B. Meyer, have published a memoir, as one of a series of communications to the Zoölogical Museum, at Dresden, "On some new or little known sponges belonging to the Hexactinellidæ found in the Philippines." It seems but the other day since one could have numbered on the fingers of one hand all the known species of this family, so well known to many by that beautiful typical form, the Venus's flower-basket (*Euplectella*), and now the number of described species is very large. In 1872 one of the authors (Dr. Meyer) was staying at Cebú, one of the Philippine group, where *Euplectella aspergillum* is a regular article of trade, quoted at so much a dozen, and where it is not surprising that he should discover a number of other lovely forms in this memoir described and figured. Among the more interesting forms are the following: *Hyatocaulus simplex*, *Mylusia zittelii*, and two species of *Aulodictyon*, all of those found being attached to the basal portion of *Euplectella*. *Semperella schultzei* is figured of a natural size from a specimen twenty-one inches in length, and figures of the spicules of the various new species are also given.—*Nature.*

— The interest in the reproduction of Batrachians is by no means yet exhausted, says *Nature*. A Spanish naturalist, Jimenez de la Espada, has recently discovered additional facts respecting *Rhinoderma darwinii* (of Chili), which was first made known by Mr. Darwin. He finds that the supposed viviparous birth of the young from the female is a very different phenomenon. It is the males

which are the nurses, and they have an extraordinary brood-sac, developed as a pouch from the throat, and extending over a great portion of the ventral surface of the animal. In this cavity a number of living tadpoles were found, in numbers of individuals, and the length of the tadpoles was about 14 mm. How these are first developed and nourished is not yet known. Dr. J. W. Spengel translates a portion of the Spanish paper in the current number of the *Zeitschrift für Wissenschaftliche Zoologie*, vol. xxix, part 4.

— We have received and are much pleased with the first two numbers of *The Young Scientist*, a popular Record of Scientific Experiments, Inventions and Progress. It is well adapted for boys, the articles being attractive and clearly written. It has our hearty sympathy and good wishes.

— MacMillan & Co., have in preparation the first part of a "Course of Instruction in Zoötomy," by Prof. Huxley, assisted by Mr. T. J. Parker. They are about to publish "A monograph on the development of Elasmobranch Fishes," by Mr. F. M. Balfour.

— During his recent five months' explorations in Costa Rica, Mr. A. Boucard collected about a thousand specimens representing 250 species of birds, some of great variety and two new to science (*Zonotrichia boucardi* and *Sapphironia boucardi* of Mulsant).

— We copy from Sir J. D. Hooker's address before the Royal Society, the following notice of the U. S. Geological Survey of the Territories, of which Professor Hayden has the charge:

Of the many surveys of the United States Territories undertaken, some by the central government, others by State governments, and still others by private enterprise, more or less aided by public funds, none has effected so much for science as that directed by Dr. Hayden. Its publications, distributed with great liberality, are in every scientific library, and its director is honored no less for the energy and zeal with which he has labored as a topographer and geologist, than for the enlightened spirit in which he has sought to render the resources of the survey available for the advancement of all branches of natural knowledge by every means in his power, and with admirable impartiality.

Having obtained an extended leave of absence from my official duties at the Royal Gardens, at the close of our last session, I accepted an invitation from Dr. Hayden to join his survey, and, in company with our foreign member, Professor Asa Gray, to visit, under his conduct, the Rocky Mountains of Colorado and Utah, with the object of contributing to the records of the survey a report on the botany of those States.

I have thus had some opportunity of learning for myself the extent and value of the operations of the survey, which are so interesting that I venture to think a brief sketch of its rise and progress and a few of its results may be acceptable to you.

When the Territory of Nebraska was admitted into the Union in 1867, Congress set apart an unexpended balance of £1,000 for a geological survey of the new State; and Dr. Hayden, then a young man who had distinguished himself as an indefatigable observer and collector (in various expeditions since 1853), was appointed to conduct it. In 1868 the operations of the survey were continued, and carried westward into the Rocky Mountains of Wyoming, the rich tertiary and cretaceous beds of which were examined and described in detail, and the famous Yellowstone district, with which Dr. Hayden's name will ever be associated, was reconnoitered. The value of the survey was immediately appreciated, and in 1869 a large appropriation was voted by Congress for placing it on its present footing under the supervision of the Secretary of the Interior. In 1869 and 1870 operations were carried on in Colorado and New Mexico; and full reports on the meteorology, agriculture, zoology, and paleontology of these regions, of great interest and importance, were drawn up and subsequently published. In 1871 the detailed survey of this Yellowstone district was begun, and those marvelous natural features were carefully studied which have excited the liveliest interest in Europe, and have induced Congress, on Dr. Hayden's representations, to appropriate the whole area as a government reserve, thus securing to naturalists free access to natural phenomena which in other places, both in Europe and America, are too often monopolized by speculators and closed to the public.

In 1872 the survey was further extended, and was organized into two corps, each provided with a topographer, geologist, mineralogist, meteorologist, and naturalist, and the States of Idaho and Montana were embraced in its operations; in 1873 it was pushed into Colorado, thence into Utah, and on its completion in 1876, an area of not less than 70,000 square miles, much of it exceedingly mountainous, had been included in the survey.

The literature of the survey, consisted, in 1876, of 41 volumes, classified as follows: 1, annual reports, with maps and sections; 2, bulletins for giving speedy publicity to new facts; 3, miscellaneous publications, comprising tables of elevations, catalogues of plants and animals, and meteorological data; 4, monographs on various branches of natural history, especially paleontology, copiously illustrated with admirable plates in quarto, among which are the works of Leidy, Lesquereux, Coues, C. Thomas, Cope, Parry, Meek, Packard, Allen, Hayden himself, and others, all of whom are well known on this side of the Atlantic; lastly, the number of photographs now exceed 4,000, and includes besides geological and geographical features of great interest, views of ancient architectural remains, and of 1,200 Indians belonging to seventy-four tribes.

In giving these particulars I speak from some personal knowledge. I wish that the same could be said of the local habitation of the survey and its museum, which I am assured contains a

very extensive and instructive collection; but these are at Washington, and my pressing duties here and at Kew prevented my visiting the federal Capital.

The most important scientific results hitherto derived from the labors of Dr. Hayden and his parties are unquestionably the geological; such as the delineation of the boundaries of the Cretaceous and Tertiary seas and lakes that occupied more than one basin of the mountain of Central North America, and the marvelous accumulation of fossil vertebrates that these ancient shores have yielded. Over an area of many hundred thousand square miles in North America there have been found, within the last very few years, beds of great extent and thickness, of all ages, from the Trias onwards, containing the well-preserved remains of so great a multitude of flying, creeping and walking things, referable to so many orders of plants and animals, and often of such gigantic proportions that the palæontologists of the states, with museums vastly larger than our own, are at a loss for space to exhibit them. So common indeed are some species, and so beautifully preserved, that I saw numbers of them, especially insects, plants and fishes, exposed for sale and eagerly purchased by travelers with confectionery and fruit, at the stalls of the railway station, from the eastern base of the Rocky mountains all the way to California.

An examination of some of these fossils has brought to light the important fact that in North America there is no recognized break between the Tertiary and Cretaceous beds. This is due to the interpolation of a vast lignitic series, the fossils of which furnish conflicting evidence. Concerning this series Dr. Hayden, who has traced it over many hundred miles, observes (Report of Geological Survey, 1874, p. 20), that the character of its palæontological as well as of its strictly geological results is such that whether the entire group be placed in the Lower Tertiary or Upper Cretaceous is unimportant, and that the testimony of the palæontologists will probably always be as conflicting as at present.

I must not end my notices of some of the labors of our scientific brethren in the United States without expressing my admiration of the spirit and the manner in which the Government and people have coöperated in making known the physical and biological features of their country, and my conviction that the results they have given to the world are, whether for magnitude or importance, greater of their kind than have been accomplished within the same time by any people or government in the older continents. How great would now be our knowledge of the climate and natural features of India and of our colonies had the excellent trigonometrical survey of the one and the territorial and geological surveys of the others been supplemented by reports such as those to which I have directed attention!

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, BIOLOGICAL AND MICROSCOPICAL SECTION, Philadelphia, January 21, 1878.—Dr. R. S. Kenderdine in the chair. Mr. Ryder related some observations which he had made on the residual image in the retina, as to the changes of color it undergoes, and as to the length of time it remains after the real image has ceased to excite the retinal cones and rods. The matter was discussed at length by Dr. Seiler, Messrs. Zentmayer, Perot and Ryder.

Mr. Potts then made an interesting communication on carnivorous plants. In the course of his remarks he gave a full description of the *Drosera*, *Dionæa* and *Nepenthes*. Of the latter he showed two preparations of the pitchers, one mounted flat in balsam, and the other in a deep cell filled with benzole, both stained with hæmatoxylin. These beautiful preparations showed the peculiar distribution of the spiral vessels and excreting as well as absorbing glands. Mr. Potts called particular attention to the fact that the spiral vessels in this plant consist of four fibres, and do not anastomose, even in the midrib of the leaf, but are collected in bundles and run alongside of each other. He also described the peculiar openings of ducts along the serrated and inverted margin of the pitcher.

Feb. 4, 1878.—At the stated meeting of the section, Mr. Jos. Zentmeyer, exhibited a cheap form of dissecting microscope, which he had designed at the instance of Prof. Rothrock, of the University of Pennsylvania, adapted to the wants of his botanical class. He set forth the advantages of the new instrument as combining steadiness, convenience of manipulation and smallness of cost, which latter is generally an important item with students of minute vegetable and animal anatomy.

Dr. McQuillen made some interesting experiments upon reflex nervous action as illustrating Pfluger's laws. Further remarks were made by Profs. Hunt, White, Houston and Dr. Kenderdine in relation to Dr. McQuillen's experiments.

Mr. Potts exhibited mounted fragmentary specimens of ants taken from the pitcher of Nepenthes, a carnivorous plant, native of Australia and the East Indies. The insects had been thoroughly digested, not a particle of soluble organic matter or protoplasm was left inside the external shell of chitin, which forms the covering of the creatures. The specimen was therefore a very instructive one, as illustrating how completely carnivorous these plants have become. The most interesting part of their structure is the presence of the honey-secreting glands on the outside which attract the ants, which, when they venture still further up the pitcher, finally are bold enough to crawl up into its mouth, never more to return, and to be drowned, digested and appropriated to nourish the structures of the invidious destroyer.

Glands of a very remarkable form are found in great numbers upon the inside of the pitcher, whose function it seems is to secrete the solvent or digestive fluid; others open in the inturned rim of the mouth, which are regarded by Dr. Hunt, their discoverer, as the only vegetable gland with a proper excretory duct.

Mr. U. C. Smith exhibited a living specimen of *Actinophrys sol.*

Mr. Ryder then remarked that he had recently seen a very curious structure in the epidermis of the skin of the soft part of a box tortoise, and indicated briefly the similarity of the horny dermal plates of this animal to those of the snakes. In continuation he observed that on making comparison of the neck vertebræ of the box tortoise with those of the great fossil armadilloes of South America, some remarkable and instructive similarities were noticed. Especially was this the case in regard to the hinge-like joint between the last vertebra of the neck and the first of the body. It indicated similarity of function, and was undoubtedly used by the armadillo to partially withdraw the head within the carapace as in the box tortoise, or at least to bring the head shield of the animal against the carapace or body shield in case of attack.

Dr. G. B. Dixon then called attention to a series of histological preparations by Dr. Carl Seiler which were referred to the conservator for examination and report.

On motion adjourned.

Boston Society of Natural History.—February 6th. Prof. W. G. Farlow gave an account of recent researches on the development of lichens, and Dr. T. M. Brewer read somes notes on the birds of New England.

Feb. 20th.—Mr. M. E. Wadsworth read some notes on the petrography of Quincy and Rockport, and Mr. C. S. Minot made a communication on the histology of the grasshopper (*Caloptenus*).

American Geographical Society, New York.—February 27th. The President, Chief-Justice Daly, delivered his annual address upon the Geographical work of the world in 1877.

Appalachian Mountain Club, Boston.—January 9th. Mr. S. H. Scudder delivered his address as retiring president, entitled A Year of Exploration in North America.

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SCIENTIFIC SERIALS.[1]

The Geographical Magazine.—February. Language-map of the East Indies, II. Further India and the Indian Archipelago, by R. Cust Memoirs of Hans Hendrik, the Greenland Eskimo,

[1] The contents of these journals are for the most part selected.

edited by H. Rink. The Island Tribe of Great Nicobar,' by Fr. A. de Röepstorff.

THE GEOLOGICAL MAGAZINE.—January. Recent Progress in Palæontology, by A. Nicholson. American Surface Geology, III, by S. V. Wood.

February.—On the Preservation of Deposits under Till or Boulder Clay, by J. Geikie.

ZEITSCHRIFT FÜR WISSENSCHAFLICHE ZOOLOGIE.—November 30. Rhizopod-studies, by E. Buck. Anatomy of the star fishes, by H. Ludwig. On the nauplius of the shrimps (Peneus), by F. Müller. The organ of smell of female Heliconid butterflies, by F. Müller. On the Natural History of Cestodes, by H. A. Pagenstecker.

January 22.—Contributions to a knowledge of the Flagellata, by O. Bütschli. On the lungs of Birgus latro, by C. Semper. The organs of copulation of the sharks, etc., by K. R. Petri. The brain of the alligator, by Rabl Rückhard.

JENAISCHE ZEITSCHRIFT FÜR NATURWISSENSCHAFT, Marz 20, 1877. The Physemaria, Gastræades of the present time, supplement to the Gastræa theory, by E. Hæckel. On the pencils of hair, felt-spots, and similar structures on the wings of male butterflies, by Fritz Müller. Contribution to the developmental History of the Lepidoptera, by B. Hatschek.

June 15.—On the structure and development of Spirochona gemmipara (an Infusorian), by R. Hertwig. Embryology of the Decapods, by P. Mayer.

November 3.—On Leptodiscus medusoides, a new Flagellate allied to Noctiluca. Studies on the Rhizopods, by R. Hertwig. On the Nervous System and Sense-Organs of the Medusæ, by O. and R. Hertwig.

THE QUARTERLY JOURNAL OF CONCHOLOGY—Nov. 1877 and Feb. 1878. Remarks on the Geographical Distribution of Terrestrial Mollusca, by C. P. Gloyne.

CANADIAN ENTOMOLOGIST—January. Notes on Lycæna pseudargiolus and its Larval History, by W. H. Edwards.

CANADIAN NATURALIST, viii, No. 6—Dec. 29. Notes on a few Dykes cutting Laurentian Rocks, more especially with reference to their microscopic structure, by B. J. Harrington. Notes on the Surface Geology of New Hampshire, by Warren Upham. Lower Carboniferous Fishes of New Brunswick. Note on a Fossil Seal from the Leda Clay of the Ottawa Valley, by J. W. Dawson.

THE

AMERICAN NATURALIST.

VOL. XII. — *MAY*, 1878. — No. 5.

HAIRS AND GLANDULAR HAIRS OF PLANTS, THEIR FORMS AND USES.

BY PROF. W. J. BEAL.

COMMON in green-houses is a plant called *Ageratum mexicanum*, which is grown chiefly for its light-blue heads of flowers which are valuable for bouquets. The stems and framework of the leaves are slightly rough on account of large numbers of hair-like projections along the entire surface. A small fragment placed under a moderate magnifying power reveals the structure of these beautiful and delicate objects as follows:

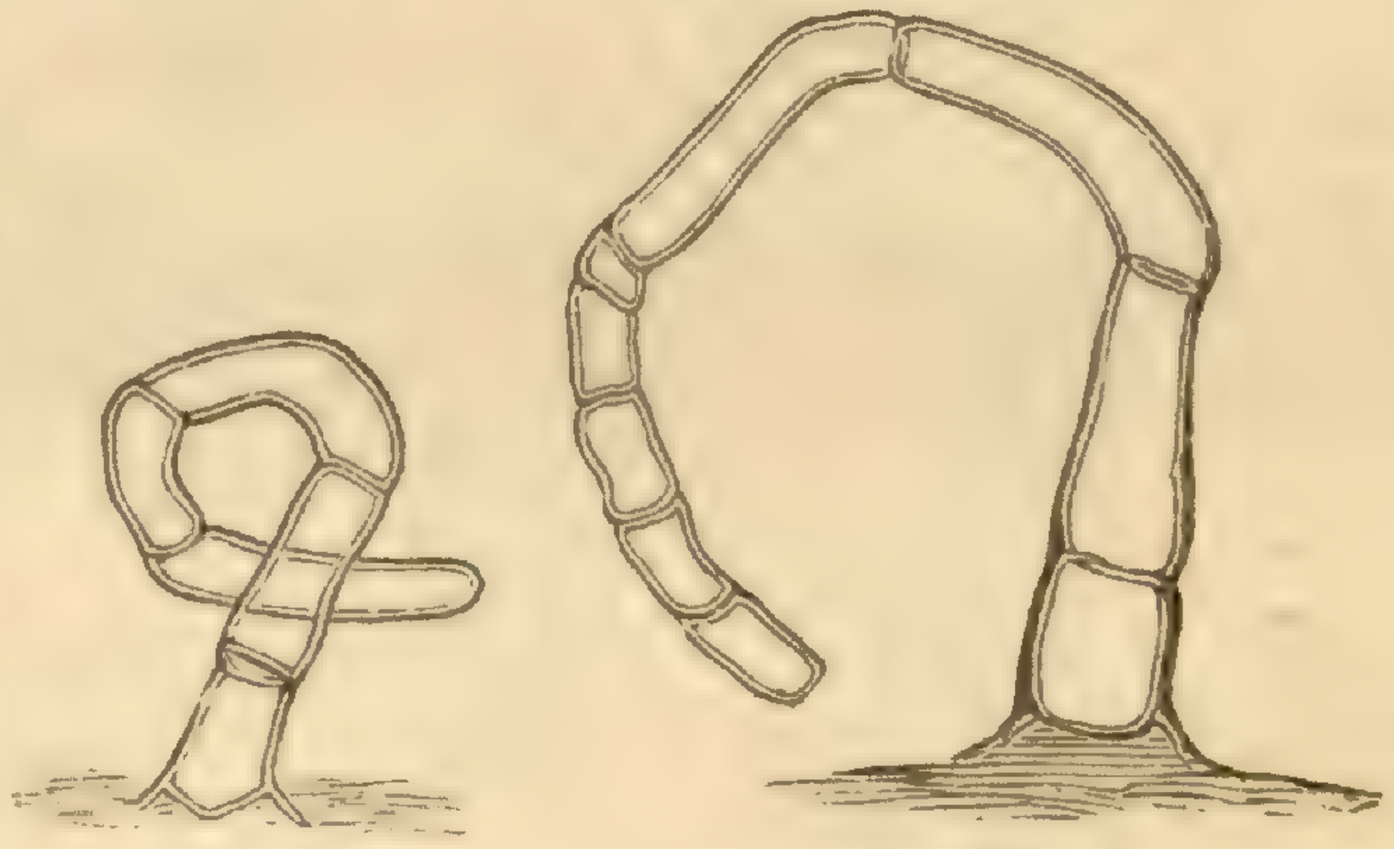

FIG. 2. FIG. 1.

Curved hairs on *Ageratum mexicanum*.[1]

The greater number of these consists of from five to twenty cells of different sizes and lengths placed end to end. Each hair or chain of cells is curved more or less, often into a complete ring, always towards the top of the plant. The end cell is blunt or rounded at the tip. Scattered among these are occasionally seen sharp-pointed hairs which are straight and much more slender. Still less frequently may be seen larger and stouter projections, like Fig. 4, in which there are two rows of

[1] The degree to which these figures are magnified is not given because of considerable uncertainty in most cases. The objects were all drawn by Mr. W. S. Holdsworth, a student in Michigan Agricultural College, generally without the use of a camera. A Wales one-fifth objective, and a B eye-piece were the highest powers used in any case.

cells overlapping each other. The lower cells are three or four times as long as broad, while towards the top the transverse diameter is the greater. The top of the projection is capped with a single hemispherical cell which is filled with a mucilaginous substance. All the other cells are in a greater or less degree transparent. They are filled with a liquid containing granules which under a magnifying power of 250 diameters are often seen to move about in steady flowing currents. Some of these glandular hairs, like Fig. 5, have but a single row of cells for the main portion of their length. Perhaps still other

FIG. 3. FIG. 4.

FIG. 3. — Slender hair of *Ageratum mexicanum*.

FIG. 4. — Glandular hairs having two rows of cells.

FIG. 5.
Hair of *Ageratum*.

FIG. 6.
Hair of *Erigeron canadense*.

FIG. 7.
Stout one-celled hair on *Panicum capillare*.

forms might be found which would be intermediate between some of these, showing more conclusively that they were modified forms of the same members.

Erigeron canadense, a common weed often known as horse-weed or mare's tail, is clothed all over its surface with slender rapidly

tapering hairs composed of a single row of cells. Many species of *Helianthus* are covered with similar hairs. The surface of *Panicum capillare*, old witch grass, is covered with slender, one-celled hairs which are straight and quite stiff for their size. The surface of a common *Physalis*, or ground cherry, abounds in slender hairs composed of from ten to fifteen cells placed in a single row. Some of these hairs terminate in a sharp point, but most of them have, at the end, a round cell like a knob, full of a sticky substance. Occasionally a hair produces one or more branches which may likewise terminate with a short point or a globular cell.

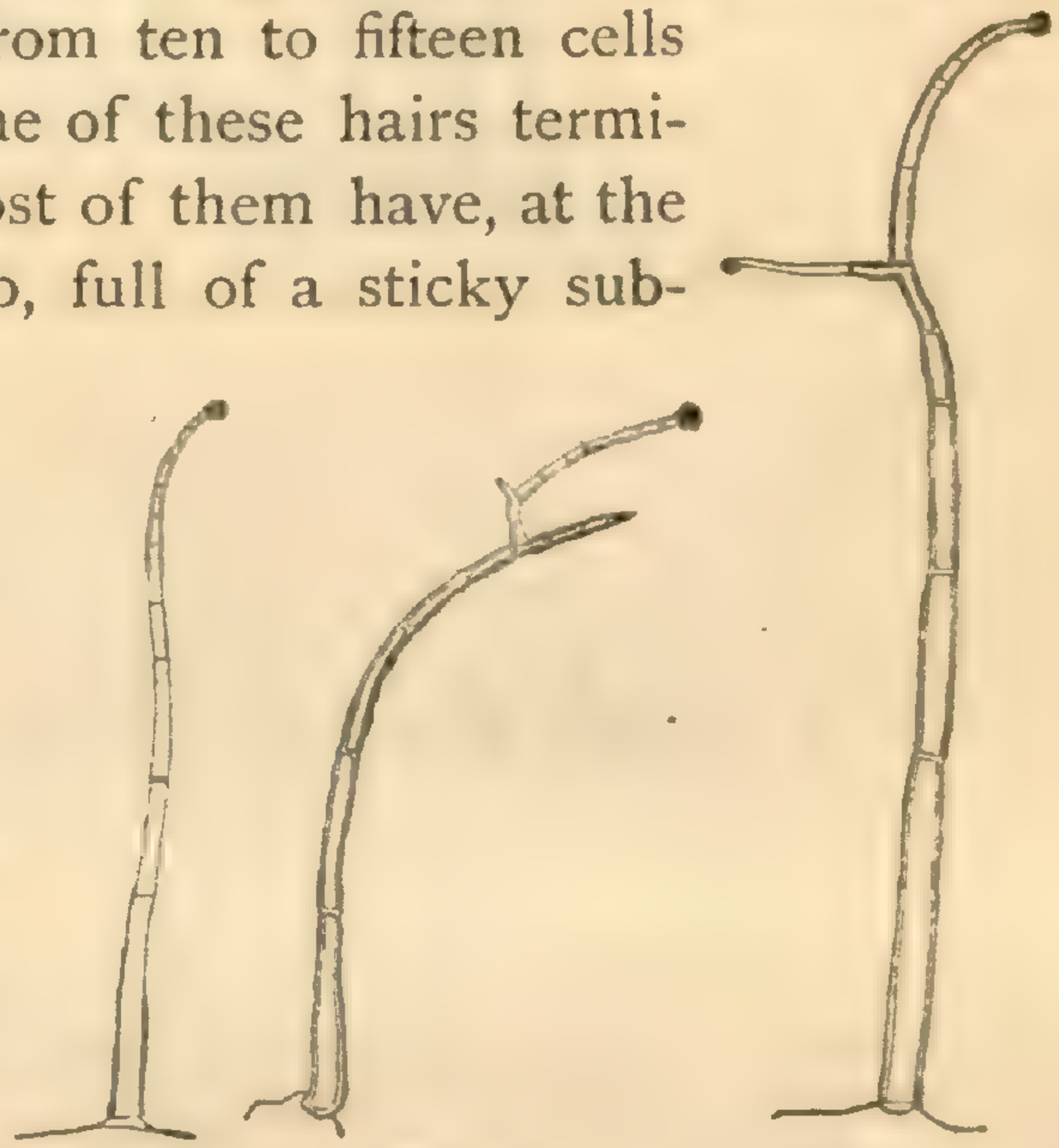

FIG. 8. FIG. 9. FIG. 10.
Hairs on surface of *Physalis*, ground cherry.

The fruit of *Circæa lutetiana*, enchanter's nightshade, is covered with rather stout one-celled hairs which have a hook at the extremity. The stems of the common butter bean of our gardens have a few scattering hairs of similar structure, though they are smaller and much more delicate.

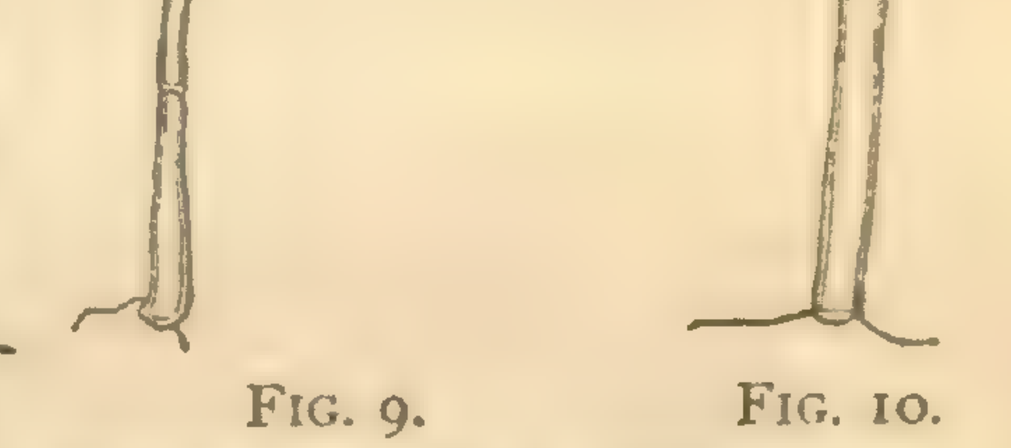

FIG. 11.—Hooked hair on fruit of *Circæa lutetiana*.

The surface of *Malva rotundifolia*, common mallow, is quite harsh to the touch on account of numerous rather stout one-celled hairs, one to six of which project from a conical protuberance. These stout hairs spread in every direction. Among the hairs

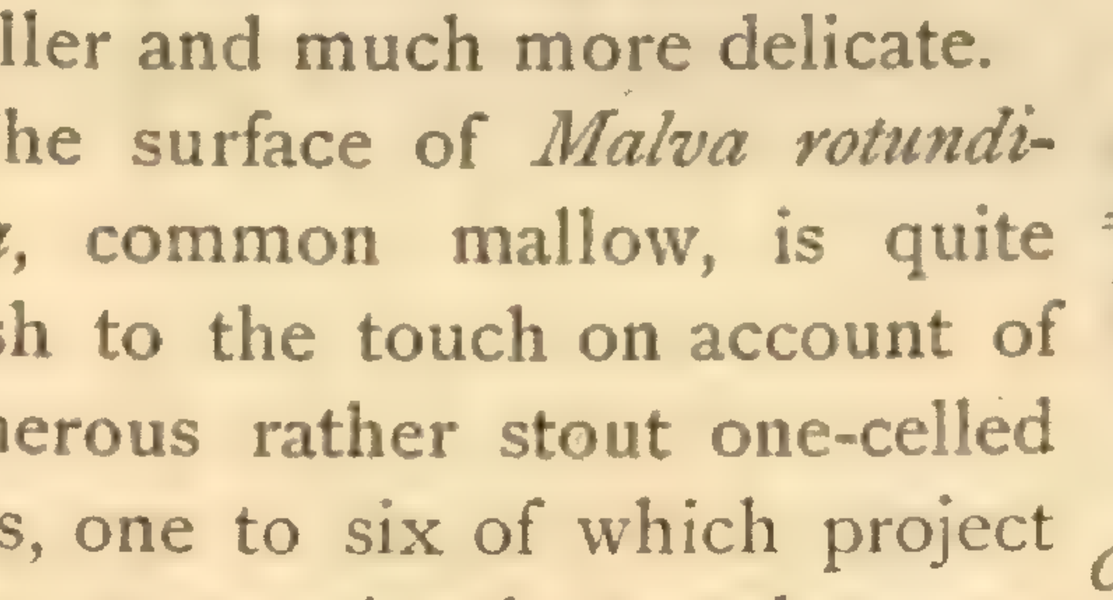

FIG. 12.
Hairs on *Malva rotundifolia*.

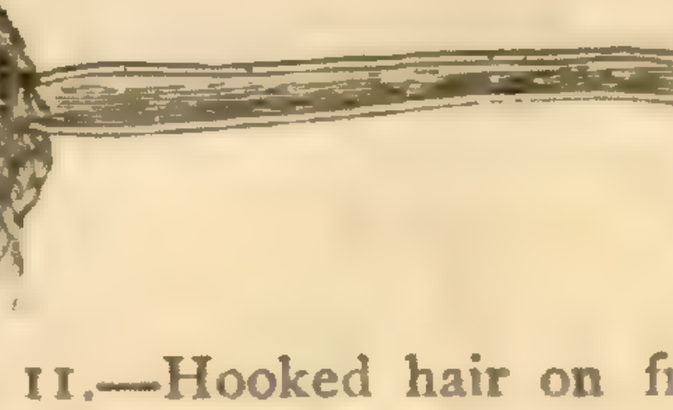

FIG. 13.
Sessile gland on same plant.

are a few sessile glands capped with two quarters of spheres.

The edges of the petioles of *Steironema* (*Lysimachia*) *ciliata*, a kind of loosestrife, are fringed with hairs, some of which are short and simple, while others are much larger and irregularly branched, like a stag's horn. Each hair whether simple or branching seems to consist of one cell, made of several pieces fitted together. The surface of *Leersia oryzoides*

FIG. 14.
Hairs on petioles of *Steironema ciliata*.

FIG. 15.—Hairs on *Leersia oryzoides*.

and *L. virginica*, rice-cut grass, is well supplied with short stout one-celled spines, all of which point downwards.

FIG. 16.—Hairs on *Galium*.

Several species of *Galium*, bed straw, are also supplied with hooks of a similar character. In these the base of each hook is quite broad and the point quite short.

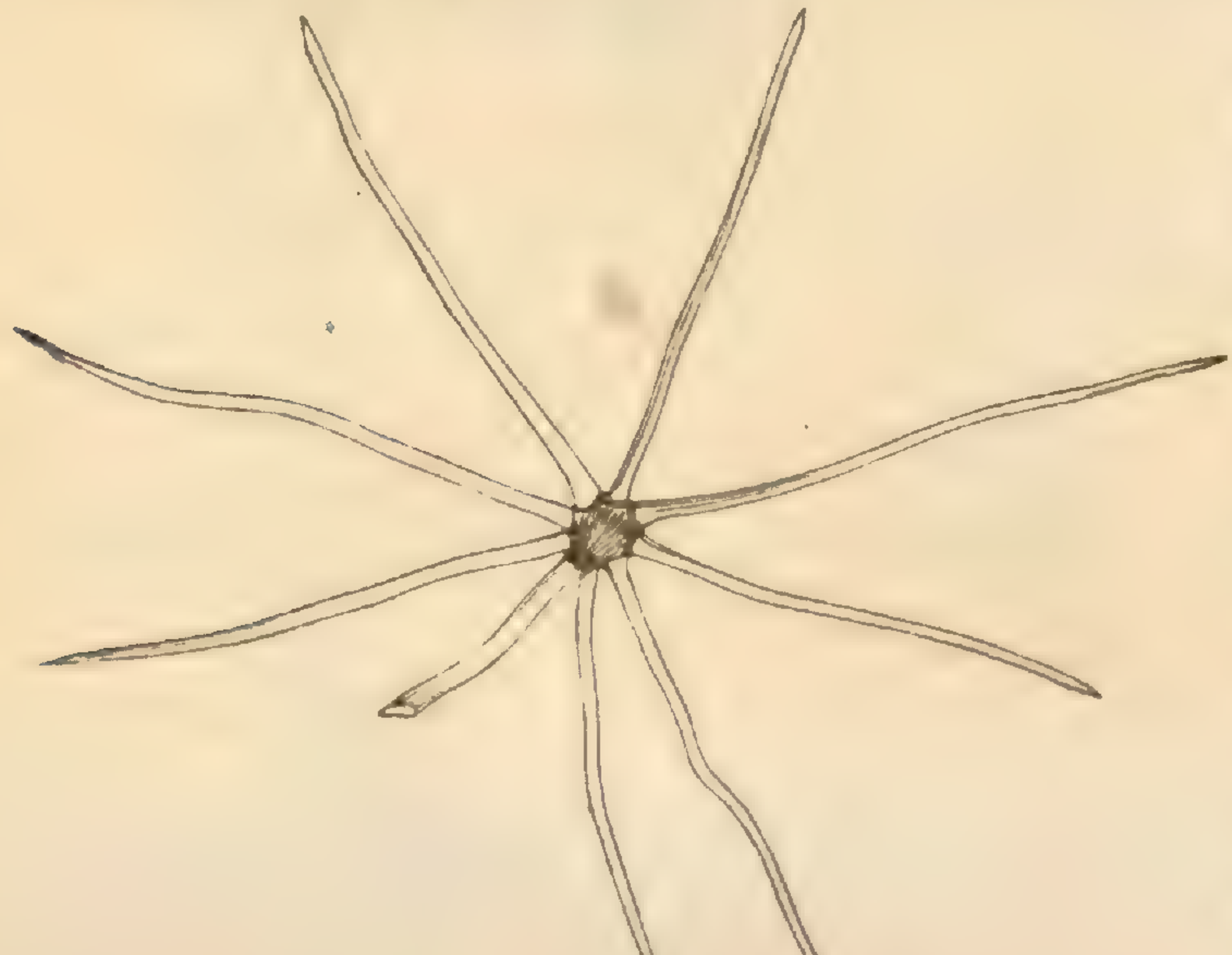

FIG. 17.—Hair on *Aralia papyrifera*.

The under surface of the leaves and the young stems of *Aralia papyrifera*, Chinese rice-paper plant, are thickly covered with a woolly substance which consists of immense numbers of one-celled stalks, each having at the tip six or more one-celled arms or rays which spread in every direction like the spokes of a wheel.

The common mullein is covered in every part with a still more abundant supply of branching hairs. The main axis of the hairs has radiating arms at different heights along its length. The glaucous nature of cabbage leaves and plums is due to numerous small cells on the surface. The mealy substance on pig weed, or lamb's quarter, consists in numerous capitate hairs.

Shepherdia canadensis is a rather rare shrub growing about the borders of lakes and seas. The young stems and buds, and portions of the leaves, are rendered red or rusty on account of the large number of scales, each of which is held to the plant by a short stem. Figs. 18 and 19 show two of

FIG. 18.—Branching hair on *Shepherdia canadensis*.

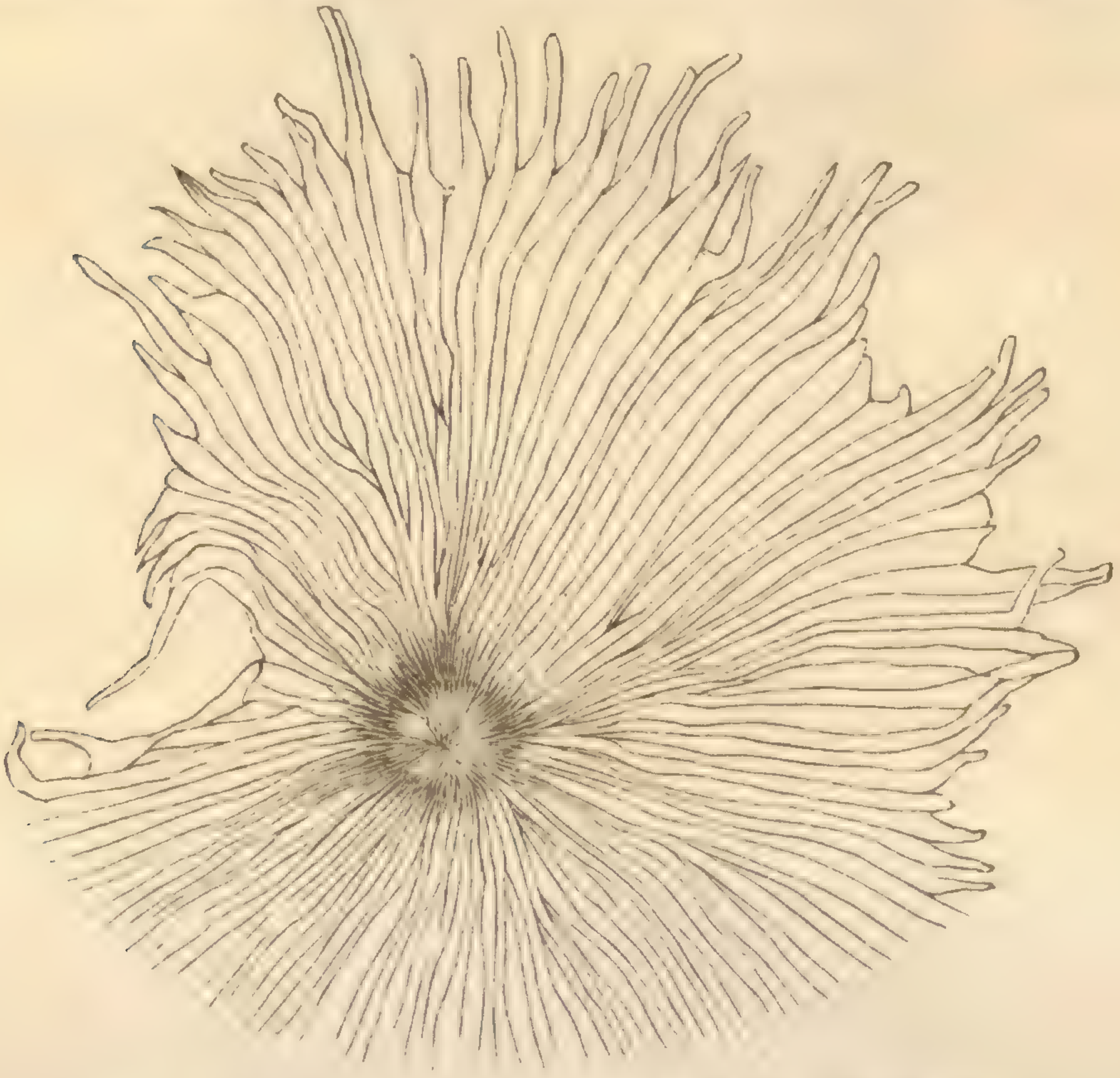

FIG. 19.—Shield-shaped scale on *Shepherdia canadensis*.

these objects. In Fig. 19 there are several rays attached side by

side throughout most of their length, while in Fig, 18 there are but few rays, which separate at once from each other. Between these two extreme specimens are found any number of intermediate forms. Much like the preceding are the star-shaped scales

FIG. 20.—Star-shaped hairs on *Deutzia scabra*.

on the leaves of *Deutzia gracilis*. There are many scales of a similar character found on most of our ferns.

De Candolle, in his Vegetable Organography, says of the hairs of plants: "Some are very tender, others very rigid, and most are of all the intermediate degrees. With regard to their direction, some are vertical to the surface from which they spring; some more or less incline forwards; others more or less backwards; some are perfectly straight, others hooked at the point; there are several which are contracted, or which are interwoven with one another. As to their form, they are found as cylinders and very cylindrically-elongated cones. They are sometimes seen in the form of reverse cones, among those that are ramified they are found forked, with two, three or a greater number of branches; or starred at their apex, or divided at their base into branches which seem as so many distinct hairs reunited into bundles, having a common base."

Sachs says, "The first indication of the formation of hairs occurs in the papillose protuberances of the epidermis of many petals, to which their velvety appearance is due. To the simplest forms belong also the root-hairs which grow from the epidermis of true roots or underground stems (*Pteris aquilina* and *equisetum*), they are thin-walled bag-like protuberances of the epidermis cells which lengthen by growth at the apex."

The *Petunia* of our gardens is rendered sticky and unpleasant to the touch on account of one-celled glands raised

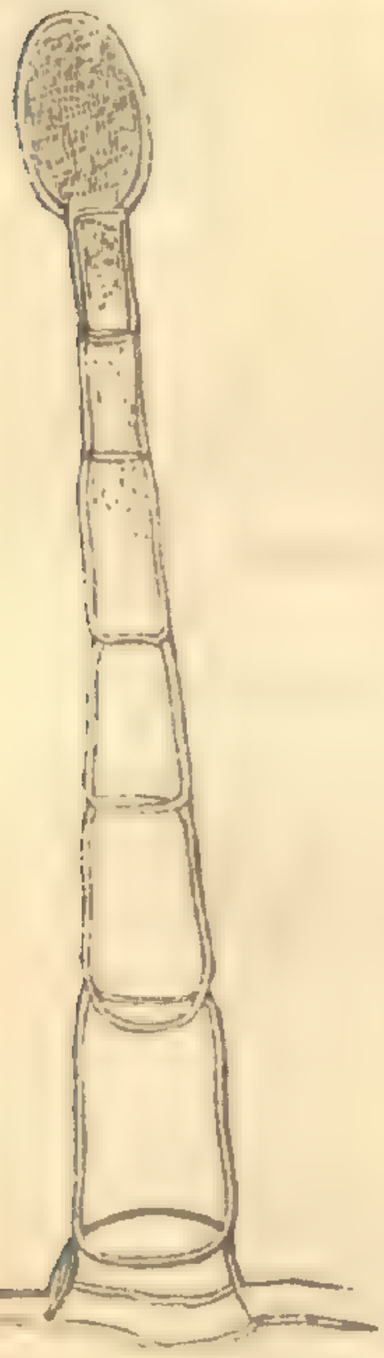

FIG. 21.
Glandular hairs of *Petunia*.

FIG. 22.

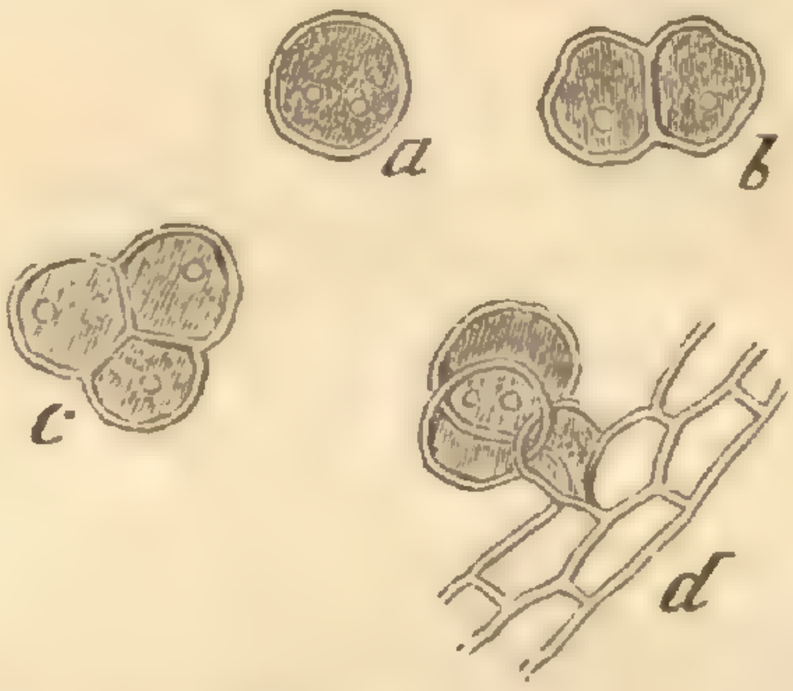

FIG. 23.
Glands on *Scrophularia nodosa*.

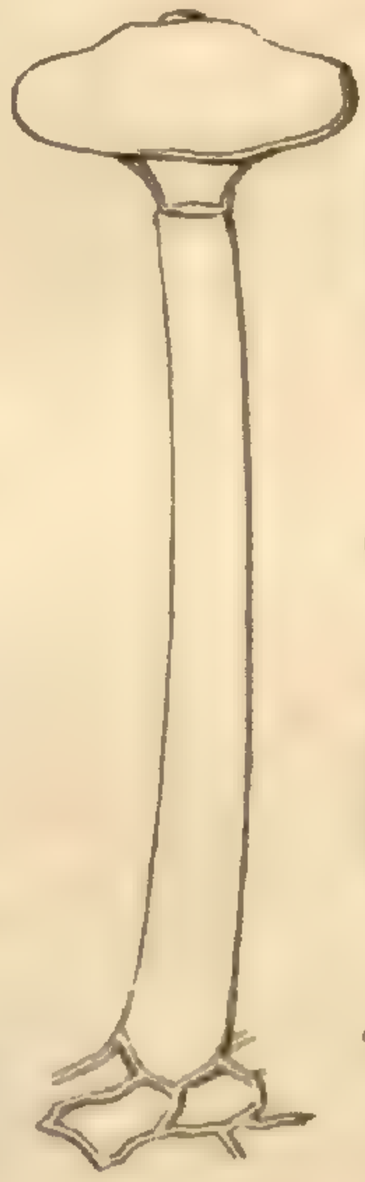

FIG. 24.
Glandular hair of *Verbena*.

FIG. 25.
Lower side of gland.

FIG. 26.
Top of gland.

on a stem of two to seven cells. *Scrophularia nodosa*, the figwort of our rich bottom lands, has numerous glands on its surface. These are composed of one, two, three or more cells raised on a short stalk. Some of the larger glands are more expanded into flattened spheres, and are much like those found on our garden verbenas next to be mentioned. The gland of the garden verbena consists of a large cluster of about thirty-five cells at the tip of a delicate stalk. The top of the gland is seen in Fig. 26, and appears to have about thirty rays and some central pieces of irregular shape. The lower surface of the gland, when it breaks off, shows two rings, one within the other. The inner is seen first, and on turning down the tube of the microscope the outer ring is seen. The gland is full of a purple substance. Figs. 27 and 28 exhibit the four-celled glands of the tomato plant. Each cell, as in many other cases, shows a nucleus, and some of them

one or more nucleoli. Besides the short hair and the gland of

FIG. 29.

FIG. 27.

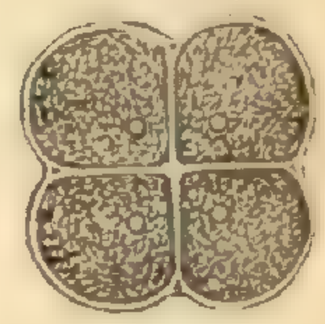

FIG. 28.

FIG. 27.—Side view of glands on Tomato. FIG. 28.—Top view. FIG. 29.—Hair and protuberance on Tomato.

the watermelon plant, shown in Figs. 30 and 31, there are large numbers of other very long-jointed hairs. Figs. 32 and 33 show us two hairs of *Phlox drummondii.* Here the glands appear to be composed of four or more cells. Some of the glands of this plant consist of a single cell. Fig. 34, *a, b* represent some of the smallest hairs on *Martynia proboscidia.*

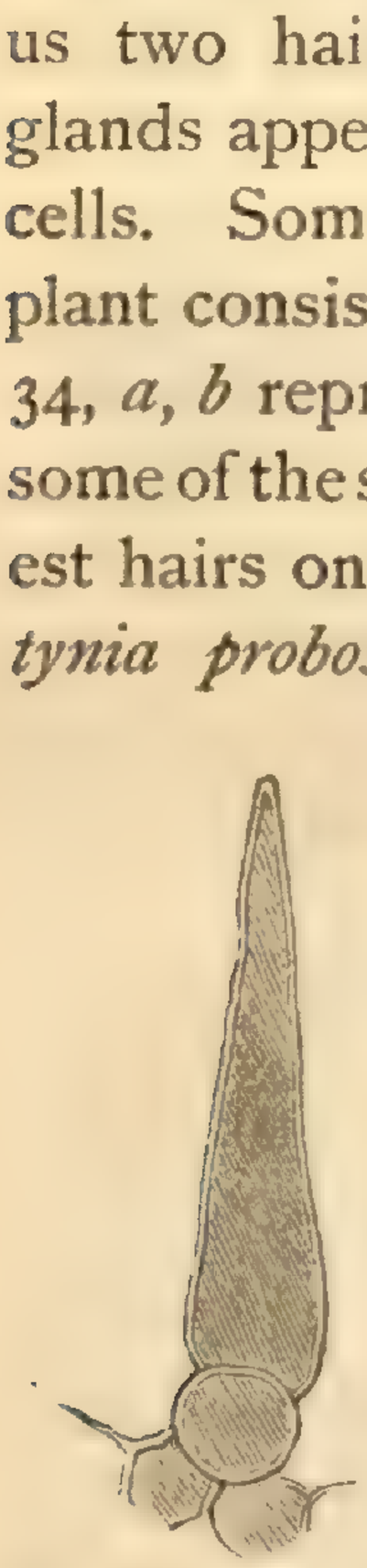

FIG. 30.
Short hair of plant of watermelon.

FIG. 31.
Glandular hair of watermelon.

FIG. 32.
Hair of *Phlox Drummondii.*

FIG. 33.
Hair of *Phlox Drummondii.*

Besides a few of these small hairs, the whole surface of the plant, including the sepals and petals, is thickly covered with glandular hairs as shown in Figs. 35, 36, 37. These glands, as do most glands of other plants to a greater or less extent, secrete a sticky substance which is usually increased in quantity by irritation.

From the end of the gland, when touched may be drawn out a gossamer thread of some length. The pulling out of the thread exhausts the gland in whole or in part, and causes it to collapse or change its shape. Fig. 36 shows a gland from which such a thread has been drawn.

FIG. 34.
Hairs of Petunia.

The fruit of *Tecoma radicans*, trumpet creeper, has on its surface numerous sessile cup-

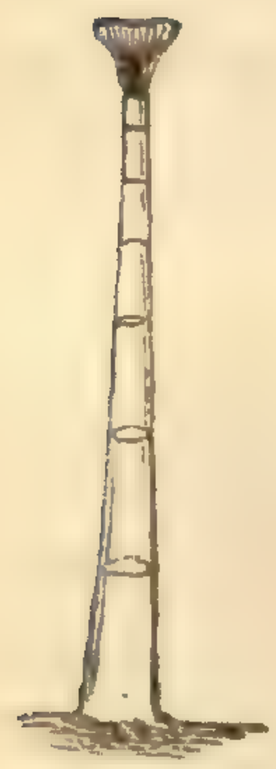

FIG. 35.

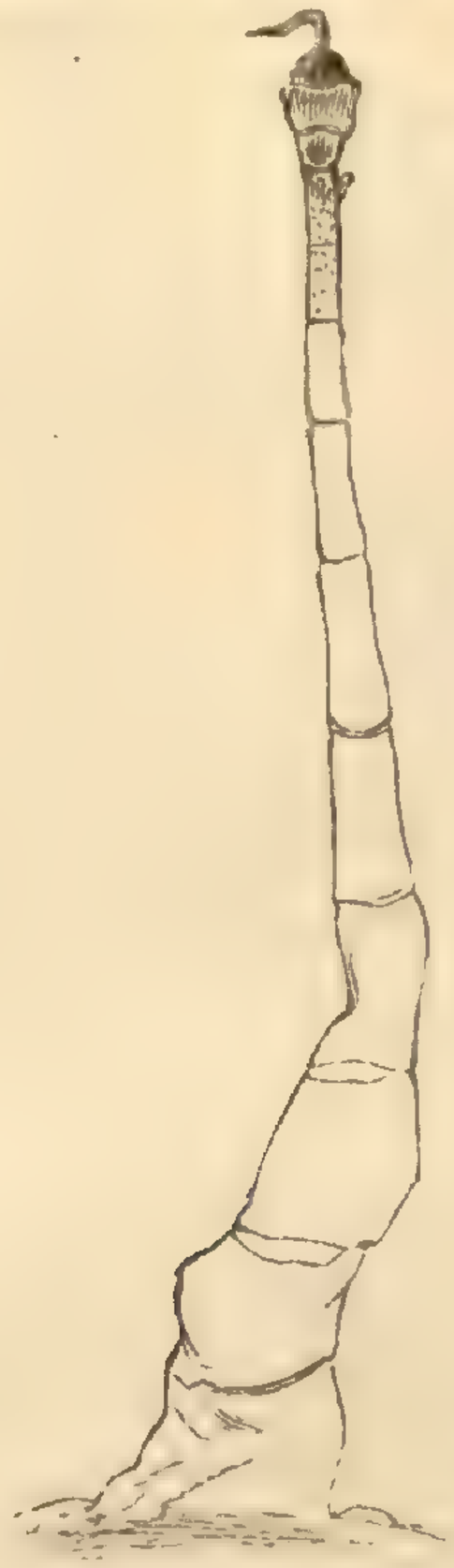

FIG. 36.

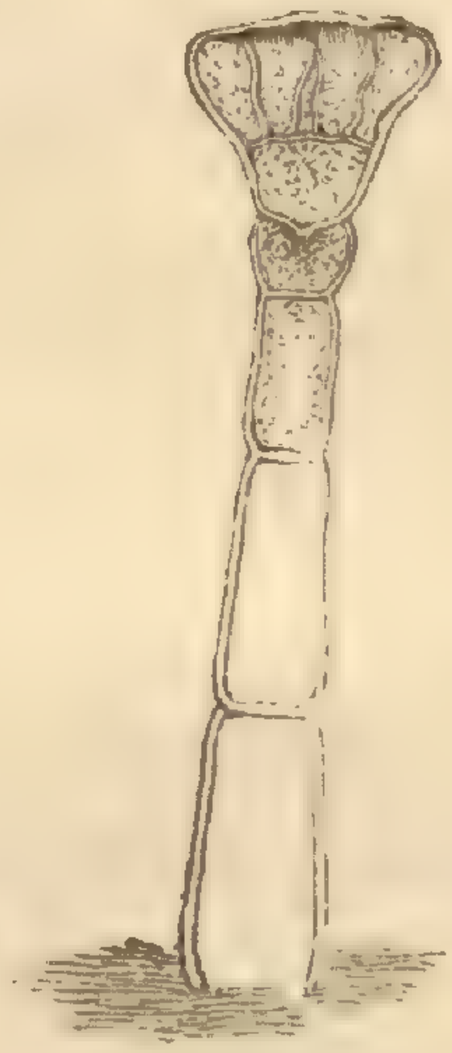

FIG. 37.

FIGS. 35, 36, 37.—Glands of *Martynia*.

FIG. 38.
Tip of gland of *Martynia*.

FIG. 39.
Tip of gland of *Martynia*.

shaped glands of which Fig. 40 shows a vertical section. In damp weather, or when not exposed to very dry air, these cups

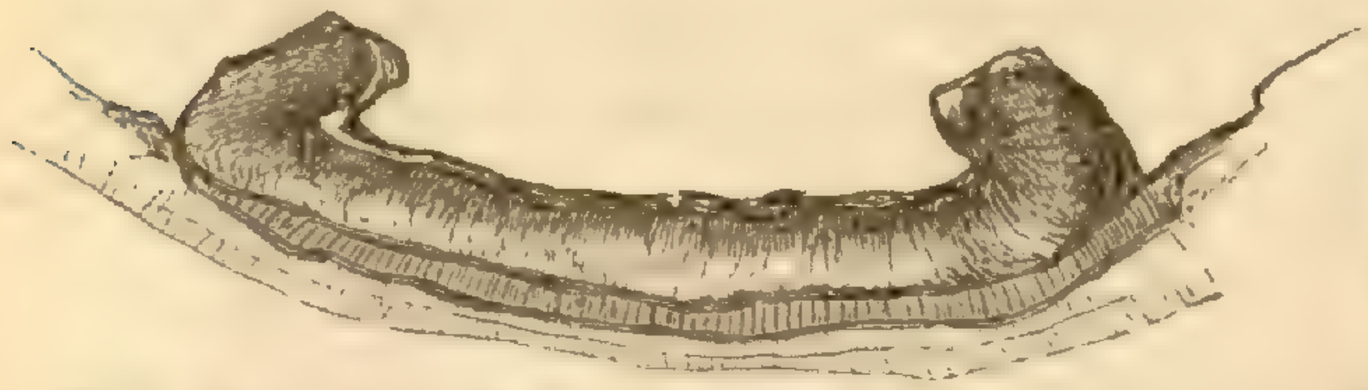

FIG. 40.—Gland of *Tecoma radicans*.

FIG. 41.—Spot on fruit of same.

FIG. 42.—Stoma on fruit of same.

are heaped full with a drop of glistening liquid in each. Besides these, on the surface are numerous spots, like Fig. 41, in which numerous cells are clustered into a circular form. From these we may find all gradations down to a two-celled stomate, as in Fig. 42.

On each margin of the petiole of *Viburnum opulus* and *Passiflora* are some cup-like glands which exude a sticky substance. Similar glands are found on the petioles of the cherry and some peaches.

For our present purpose enough of these hairs and glands have been described and illustrated. A large majority of plants possesses something of this nature in a greater or less degree. When fresh, and especially when not exposed to direct sunlight or air which is too dry, these glands are covered with a spherical glistening drop which is often several times the diameter of the gland.

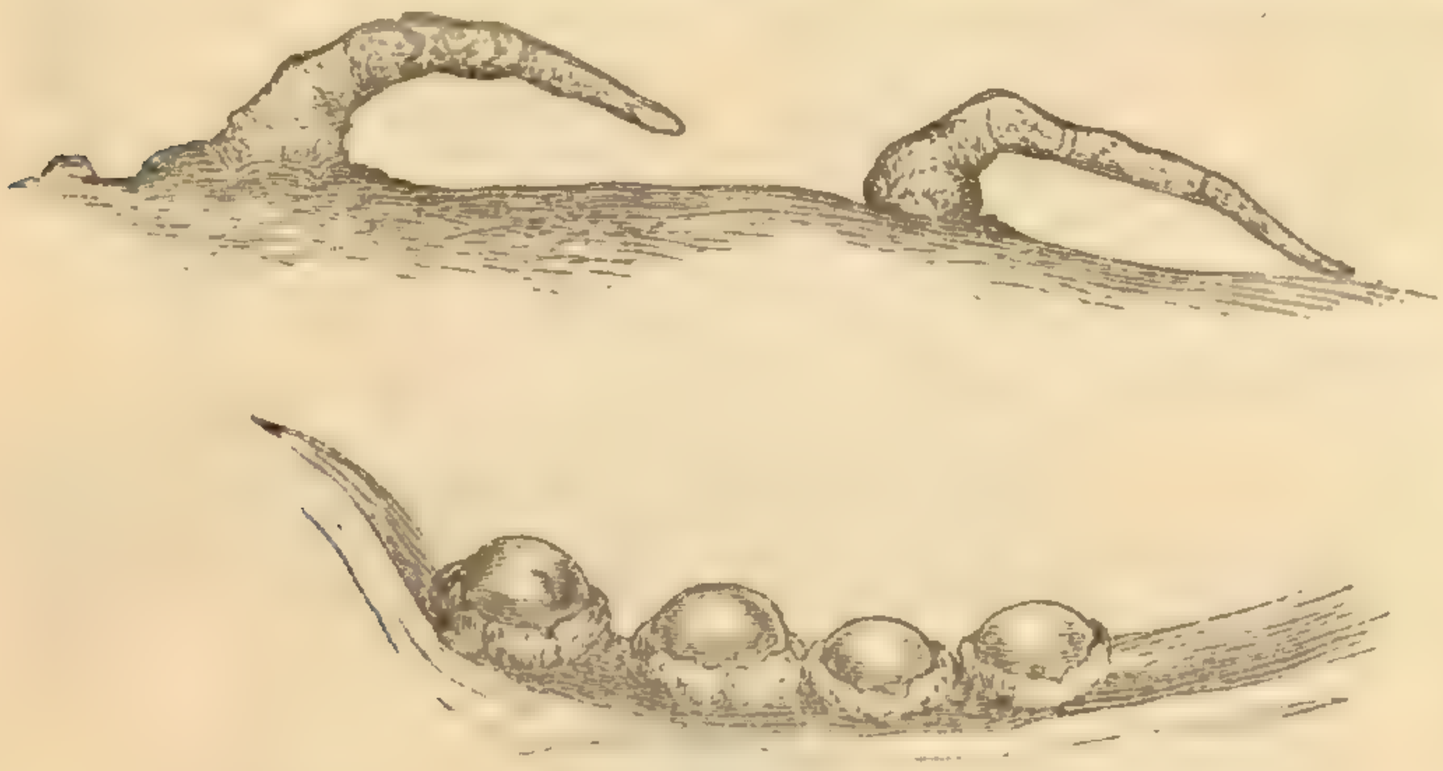

FIG. 43.—Glands on petiole of Snowball.

The uses of these hairs and glands we probably now understand to some extent, but in other cases we can only guess their office. The slender-pointed hairs may serve to some extent to ward off insects. These and the scale-like hairs may prevent the delicate surface from being scorched by the sun. This is not very probable, because most of the hairs on leaves are on the under side away from the direct rays of the sun. In the case of the common mullein, the thick branching hairs probably make the plant offensive to cattle and other animals. In a similar way other plants are protected from animals.

When packed within the bud scales during winter, the young leaves and flowers of many of our trees and shrubs are well protected by these soft hairs which envelope the tender parts like a mass of cotton or wool. After expansion of the buds these hairs generally drop off.

When the hairs or spines are stout and point backward, as in *Galium* and *Leersia*, they serve well to hold up the weak plant as it rises among stouter objects.

Fruit with hooked hairs is likely to be scattered by holding fast to animals. The bloom on a cabbage leaf or plum, and the thick hairs on plants prevent them from becoming wet on the surface. The shield and star-shaped scales on *Shepherdia* and *Deutzia*, and others, may serve the same purposes as hairs. These delicate objects must protect the plant from injury on account of sudden changes of the weather. The advantage of the sting of the nettle to the plant is obviously a means of self-protection.

The function of glandular hairs in some cases is a great mystery. In the case of *Martynia* the writer found it caught immense numbers of small insects, and in some way seems to suck out their substance. Small insects are found to a greater or less extent caught and held fast by the glandular hairs on all or most of the plants which produce glands. In his Insectivorous Plants Mr. Darwin, by experimenting, concludes that the glands of *Droseras* devour animal substances. The same conclusion is reached in case of numerous other plants, as some *Saxifragas*, *Primulas*, *Pelargoniums*, *Pinguiculas*.

The glands of the trumpet creeper are active, even till the fruit is of full size and quite near maturity. They are much visited by flies, wasps, and especially by ants to such an extent that the plant is often considered a nuisance when placed near the house. The glands on the leaves of cherry trees and *Viburnum* are also much frequented by insects. The base of the leaves of the sunflower, locust, *Pteris aquilina* (a fern) and numerous other plants are freely visited by insects. Of what benefit it can be to *Tecoma*, *Pteris*, *Heliantlus* and the cherry to be thus visited by ants is beyond my certain knowledge.

The glands of tomatoes, tobacco, petunia and many other plants secrete a substance which is offensive to most insects and other animals which might otherwise devour the plants.

Mr. Darwin has also shown that some of these plants do certainly absorb and appropriate gaseous and liquid bodies. Many ingenious experiments were made on plants of several different orders, showing that "they detect with almost unerring certainty the presence of nitrogen." Plants by their glands were fed with green-peas, raw meat, a decoction of grass leaves. These substances "are acted on in exactly the same manner as by gastric juice."

Why may not these glands also draw nourishment from the particles of dust which fall on them from the air, or from the particles of soil which in many cases accumulates to such an extent as to completely cover some portions of the plant? As root hairs are active in absorbing materials from the soil including something from solid substances, why should not these active glands absorb materials from the dust and fragments of soil? The free presence of the air and light may also assist in this supposed action. This covering of the plant by the particles of soil held by

the hairs and glands may also save the plant from destruction by animals.

Of one thing the writer is certain, that these delicate objects are interesting to study. Situated as they are in immense numbers and in such great variety on the surface of so many plants, they are easily obtained and easily prepared for examination. They are excellent objects for a beginner in the use of the compound microscope; and for protracted and careful experiments, they are worthy the skill of the most accomplished scientist. In them we may spend weeks to advantage in observing the development of cells, the nucleus and nucleoli, and the gyration of the sap. In form and color they are exquisitely beautiful, while in variety they are inexhaustible.

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ON THE TRANSFORMATIONS AND HABITS OF THE BLISTER-BEETLES.

BY CHAS. V. RILEY, A.M., PH.D.

[*Continued from the April Number.*]

History of Epicauta.—It is generally stated by writers on the Hive-bee that the Oil-beetle (*Meloë*) is one of its parasites. The possibility that our more common blister-beetles were similarly parasitic on bees, taken in connection with the frequent complaints from apiarians of the wholesale death of bees from causes little understood, led me, some years since, to pay attention to the biological characteristics of the blister-beetles, in the hope of ascertaining whether or not they really bear any connection with bee mortality. From these investigations I am satisfied that *Meloë* is only parasitic on the perfect Hive-bee as it is on so many other winged insects that frequent flowers; and that it cannot well, in the nature of the case, breed in the cells of any social bee whose young are fed by nurses in open cells.

I have had no difficulty in getting the eggs or the first larva of several of our vesicants, and described some of them at the Hartford (1874) meeting of the Am. Ass. Adv. Sc.; but these young larvæ refused to climb on to plants furnished to them, or to fasten to bees or other hairy insects. Nor would they nourish upon honey, bee-bread, or bee larvæ on which they were placed. They showed a proclivity for burrowing in the ground, and acted quite differently from those of *Meloë* or *Sitaris*, which not

only readily attach to bees in confinement, but which, in the case of *Meloë*, I have known to so crowd upon mature hive bees as to worry them to death and cause extended loss in the apiary. Explorations into the nests of Solitary bees gave no clue, and, in fact, the immense numbers in which the more common blister-beetles occur, rendered a parasitic life upon such bees highly improbable. In sweeping plants and flowers with the net, I had never met with any of the first larvæ with which I had become familiar, as already indicated; while I had on several occasions, in digging ground where there was no trace of bee nests, met with the curious pseudo-pupa so characteristic of the family. While analogy and the law of unity of habit in species of the same family pointed, therefore, to a parasitic life, I began to conclude, from the facts just stated, that the parasitism was of another kind, having satisfied myself by various experiments that the triungulins did not feed on roots. Few discoveries are stumbled upon. We find as a rule that only which we anticipate or look for. In 1876, in digging up the eggs of the Rocky Mountain locust (*Caloptenus spretus*) at Manhattan, Kansas, the pseudo-pupæ were not unfrequently met with. The thought at once occurred to me that locust eggs might be the proper food for these blister-beetle larvæ, and it was encouraged by the fact that the Meloids abound most in those dry western regions where the Acrididæ most prevail, and by a pretty distinct recollection, which my notes support, that the years when the vesicants were most injurious to potatoes had been preceded by dry Falls, during which there had been much locust injury and, necessarily, unusual locust increase. The suspicion thus raised that these blister-beetles preyed in the preparatory states upon locust eggs was confirmed last spring by finding the larvæ of different ages within the egg-pods and devouring the eggs of *Caloptenus spretus*. Mr. A.N.Godfrey had, also,

FIG. 3—*Epicauta vittata*: normal form.

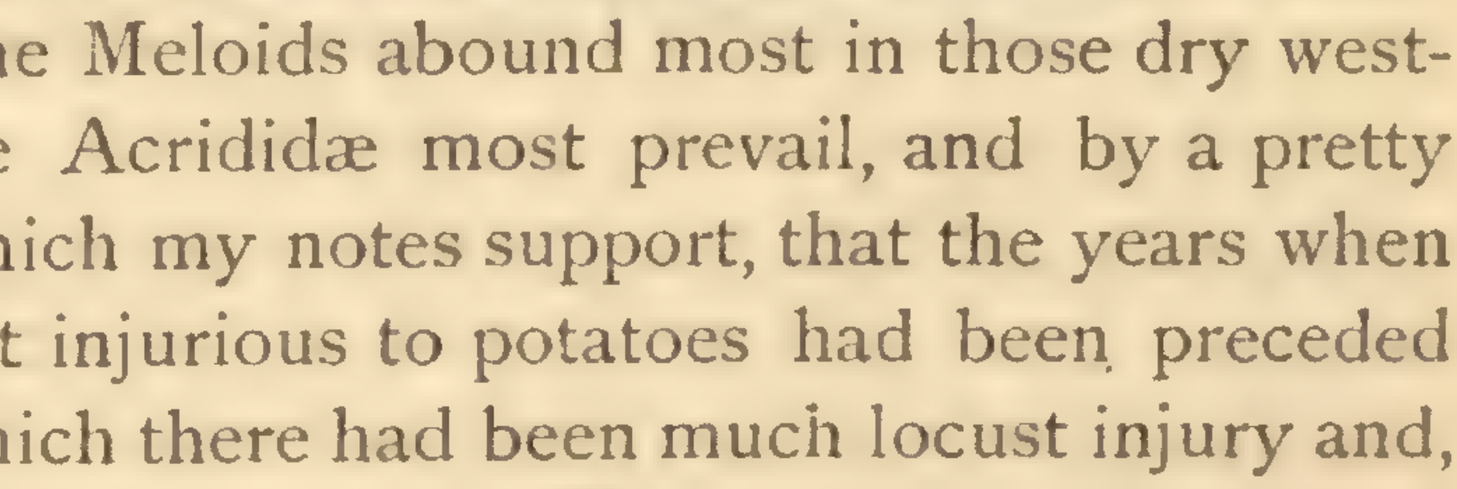

FIG. 4.—*Macrobasis unicolor*:—*a* normal, gray form; *b*, black (*murina*) form; *c*, *d*, male and female antennæ of either.

no difficulty, under my directions, in finding them last May at Manhattan; while they were sent to me among other locust-egg parasites by Mr. Seth H. Kenney of Morristown, Minn., and from St. Peters in the same State by Prof. Cyrus Thomas.

From such larvæ preying on the eggs of *C. spretus* I have reared the unicolorous form of *Epicauta cinerea* (Forster), or the margined Blister-beetle[1]; the *Epicauta pensylvanica* (DeGeer),[2] or the Black Blister-beetle; the *Macrobasis unicolor* (Kirby)[3] or the ash-gray blister-beetle; and the form of it described as *murina* by LeConte, or the black-rat blister-beetle.

Since then I have found it very easy to trace the larval habits and development of the two more common potato-feeding species around St. Louis, viz: the striped blister-beetle (*Epicauta vittata*, Fabr.)[4] and the Margined Blister-beetle (*marginata* Fabr.) just alluded to.

Careful examination of locust eggs in the vicinity of potato fields frequented by these beetles show a varying proportion of the egg-pods affected, and in some locations nearly every pod of the differential locust (*Caloptenus differentialis*) will contain the *Epicauta* larva. The eggs of this locust are laid in large masses of 70 to about 100. The pod is but slightly bent, rather compact outside, while the eggs are irregularly ar-

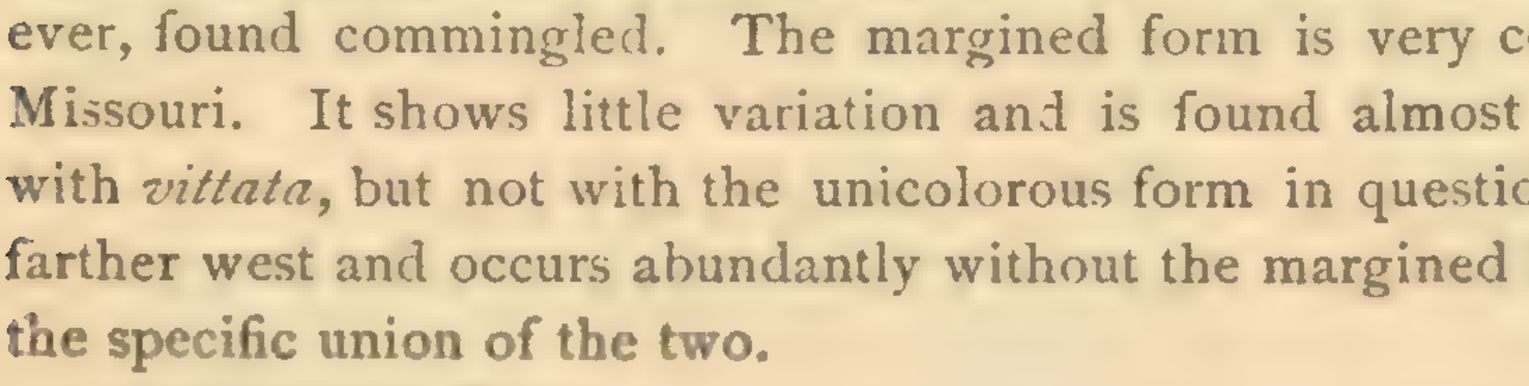

FIG. 5.—*Caloptenus differentialis.*

[1] The black, gray-margined form, very appropriately described by Fabricius as *marginata*, is referred to *cinerea* Forster by modern systematists, and specifically united with it by Dr. Horn. Yet the fact remains that the two are not ordinarily, if ever, found commingled. The margined form is very common in potato fields in Missouri. It shows little variation and is found almost invariably in conjunction with *vittata*, but not with the unicolorous form in question, which is most common farther west and occurs abundantly without the margined form—all which is against the specific union of the two.

[2] = *E. atrata* Fabr.

[3] = *M. cinerea* Fabr., *Fabricii* Lec., *murina* Lec., *debilis* Lec. I accept Dr. Horn's conclusion that the last two are but poorly developed forms of this species. Yet the *murina* form is not due to rubbing or injury, but issues from the pupa without a trace of gray scales on the elytra.

[4] = *E. lemniscata* Fabr. Dr. Horn retains *lemniscata* as a distinct species in his Revision already referred to. The outer stripe in the bi-vittate specimens divides up in others so as to give the tri-vittate character on which *lemniscata* is founded. Both extremes and every possible variation between them occur constantly together in the same potato field in Missouri, and there are no other differences of specific value.

ranged, and capped with but a shallow covering of mucous matter. It is the egg-pod of this species which the larvæ of the two Blister-beetles in question prefer; for while they will feed upon those of other species in confinement, I have so far found none in the deeper-necked, narrower, more compact egg-pods either of *Caloptenus femur-rubrum*, *C. Atlantis*, or *Œdipoda sulphurea*, in which the eggs are regularly and quadrilinearly arranged, as in those of *C. spretus*. Not only have I found a large proportion of the egg-pods of *C. differentialis* naturally infested with these *Epicauta* larvæ, but I have succeeded in hatching and rearing numbers in-doors.

From July till the middle of October the eggs are being laid in the ground in loose, irregular masses of about 130 on an average —the female excavating a hole for the purpose, and afterwards covering up the mass by scratching with her feet. In confinement she sometimes omits both these instinctive acts and oviposits on the surface of the ground. She lays at several different intervals, producing in the aggregate probably from four to five hundred ova, judging from examinations made on the ovaries of some that were gravid. She prefers for purposes of oviposition the very same warm sunny locations chosen by the locusts, and doubtless instinctively places her eggs near those of these last, as I have on several occasions found them in close proximity. In the course of about 10 days—more or less, according to the temperature of the ground—the first larva or triungulin hatches. The hatching takes place without the aid of any *ruptor ovi*, for the egg-shell is so delicate that it easily splits, from mere expansion, along the back near the head, and breaks and shrivels up with the escape of the larva. These little triungulins (Pl. 1., Fig. 2), at first feeble and perfectly white, soon assume their natural light brown color and commence to move about. At night or during cold or wet weather all those of a batch huddle together with little motion, but when warmed by the sun they become very active, running with their long legs over the ground, and prying with their large heads and strong jaws into every crease and crevice in the soil, into which, in due time, they burrow and hide. Under the microscope they are seen to fairly bristle with spinous hairs, which aid in burrowing. As becomes a carnivorous creature, whose prey must be industriously sought, they display great power of endurance, and will survive for a fortnight without food

in a moderate temperature. Yet in the search for locust eggs many are, without doubt, doomed to perish, and only the more fortunate succeed in finding appropriate diet. Upon the slightest disturbance they curl up in a ball with the head bent pretty closely on the breast.

Reaching a locust egg-pod, our triungulin, by chance, or instinct, or both combined, commences to burrow through the mucous neck, or covering, and makes its first repast thereon. If it has been long in the search, and its jaws are well hardened, it makes quick work through this porous and cellular matter, and at once gnaws away at an egg, first devouring a portion of the shell, and then, in the course of two or three days, sucking up the contents. Should two or more triungulins enter the same egg-pod, a deadly conflict sooner or later ensues until one alone remains the victorious possessor. By the time the contents of an egg are consumed, the body of the parasite has perceptibly increased so that the white sutures between the segmental plates show conspicuously, especially as there is a tendency on the part of the animal to curve its body, and bring the sutures more into relief. A second egg is attacked and more or less completely exhausted of its contents, when a period of rest ensues, the triungulin skin splits along the back and there issues the *Second Larva* (Pl. 1., Fig. 4)—white, soft, with reduced legs and quite different in general appearance from the first. This molt is experienced about the eighth day from the first taking of nourishment. The animal now naturally lies in a curved position (Pl. 1., Fig. 4, *d*), but, if extracted from the egg-pod, will stretch itself and move with great activity, reminding one very strongly of many Carabid larvæ, for which reason I would designate this as the *Carabidoid* stage of the second larva. After feeding for about another week, a second molt takes place, the skin, as before, splitting along the back and the new larva hunching out of it until the extremities are brought together and released almost simultaneously. This kind of molting, which is characteristic of our blister-beetles up to the pseudo-pupal state, is exceptional among insects, the skin being ordinarily worked backward from the head. The modification at this molt is slight. The mouth-parts and legs become rudimentary and the body takes on more fully the clumsy aspect of the typical Lamellicorn larva, for which reason I designate this as the *Scarabæidoid* stage of the second larva.

Another six or seven days elapse and the scarabæidoid skin is rent and shed with but slight modification in the form and characters of the animal. In this, the Ultimate stage of the second larva (Pl. 1., Fig. 5) the creature grows apace, its head being constantly bathed in the rich juices of the locust eggs, which it now rapidly sucks or more or less completely devours. The color is more yellowish than it was before, and the power to stretch and travel on the venter on an even surface is still retained. In another week it forsakes the remnants of the pabular mass, and, by burrowing a short distance in the clear soil, avoids the deleterious decaying influences of these egg remnants. In the soil it forms a smooth cavity, within which it lies stretched on one side, motionless and gradually contracting. The skin separates and becomes loose at the end of the third or fourth day, when it splits on the top of the head and thoracic joints and is worked toward the extremity, but never fully shed. The mouth-parts and legs are now quite rudimentary and tuberculous, the soft skin rapidly becomes rigid and of a deeper yellow color, and we have what has been called the semi-pupa (Pl. 1., Fig. 8). The term pseudo-pupa given it by Fabre is more appropriate, and I should prefer myself to call it the *coarctate larva*, for it is nothing but a rigid and dormant larval stage, having its counterpart in the well-known "flax-seed" stage of the Hessian-fly larva and in the so-called coarctate pupa of the Diptera generally. A similar dormant but less rigid larval stage occurs with many Tenthredinidæ in Hymenoptera, and, in fact, the summer dormancy of certain Lepidopterous larvæ and the winter dormancy of others is analogous. We find something similar, therefore, in all the orders undergoing complete transformations, but in no insects is the change so marked and exceptional or the freeing of the subsequent larva from the coarctate larva so striking as in these Meloidæ. The insect has the power of remaining in this coarctate larval condition for a long period, and generally thus hybernates.

In spring the coarctate larval skin is, in its turn, rent on the top of the head and thorax, and there crawls out of it the *Third Larva*,[1] which differs in no respect from the ultimate stage of the second larva already mentioned, except in the somewhat reduced

[1] The coarctate larva is, properly speaking, the third, and that following it the fourth; but just as I have preferred to designate as special stages of the second larva the stages between the first and fourth molts, so I prefer to call the last larva the third, to conform to the nomenclature now generally employed.

size and greater whiteness. The coarctate skin, when deserted, retains its original form almost intact. The third larva is rather active, and burrows about in the ground; but while there seems to be no reason why it should not feed, nourishment is not at all essential, and all my specimens have, in the course of a few days, transformed to the true pupa without feeding. In the transformation to pupa (Pl. 1., Fig. 9) the third larval skin is worked into a wrinkled mass behind, as is also the skin of the true pupa when shed. The pupa state lasts but five or six days, and before the wings of the imago are fully expanded, or the abdomen contracted, the general aspect of *Epicauta* forcibly recalls the mature *Henous*.

Like all parasitic[1] insects that nourish on a limited amount of food and possess no power to secure more, the blister-beetles vary greatly in individual size in the same species, and the larvæ have the power of accommodating their life to circumstances, and of assuming the coarctate larval form earlier or later according to the size of the egg-mass which they infest. I have had some interesting illustrations of this in my experiments with them. In an average sized egg-pod of the differential locust, however, there are more than enough eggs to nourish the largest specimen of *E. vittata*, and a few are usually left untouched.

The period of growth, from the first feeding to the coarctate larva, averages, as will be gathered from the foregoing, about a month; yet in the month of September, out-doors, under screens where I have had the differential locust oviposit for the experiment, I have known the full larval growth of *E. vittata* to occupy but 24 days. As this species occurs in the beetle state as early as June in the latitude of St. Louis and as late as October, there are possibly two annual generations here and farther south.

Larval Habits of Macrobasis and Henous.—The characteristics of the triungulins of the blister-beetles, represented by *Epicauta* and *Henous*, are remarkably similar, and point to unity of habit. The same holds true of the characters of the second, coarctate and third larva and of the pupa of *Epicauta* and *Macrobasis*. They are precisely alike; so that, while appreciable differences may be found in the triungulins, it is doubtful whether the subse-

[1] An insect is not properly parasitic that simply feeds on eggs, but the term is permissible and even necessary to characterize and distinguish those species which develop within and are confined to a locust egg-pod, from the predaceous species that are not confined but pass from one pod to another.

quent developmental stages will indicate specific or even generic differences in species of similar size in these three genera.

That the eggs of *Epicauta* may exceptionally hybernate is possible, but, from their delicate nature, improbable. That the triungulins frequently do so there can be no doubt, especially in species like the Black Blister-beetle, which is found on the flowers of Solidago, Eupatorium, etc., till the end of October, and continues laying till frost. I have at the present time (November) many of these last that are quietly huddled together, and, with winter temperature, will doubtless remain so; while others have worked in between the locust eggs, there evidently to remain without feeding till spring opens. I have also found as many as five triungulins of this species curled up in the deep red mucous matter that surrounds the eggs of *Œdipoda phanæcoptera*—all numb and torpid, and evidently hybernating.

Conclusion.—From the foregoing history of our commoner blister-beetles, it is clear that while they pass through the curious hypermetamorphoses so characteristic of the family, and have many other features in common, yet *Epicauta* and *Macrobasis* differ in many important respects from *Meloë* and *Sitaris*, the only genera hitherto fully known biologically. To resume what is known of the larval habits of the family, we have:

1st—The small, smooth, unarmed, tapering triungulin of the prolific *Sitaris*, with the thoracic joints subequal, with strong arcuiculating, tarsal claws on the stout-thighed but spineless[1] legs, and, in addition, a caudal spinning apparatus. The mandibles scarcely extend beyond the labrum; the creature seeks the light, and is admirably adapted to adhering to bees but not to burrowing in the ground. The second larva is mellivorous, and the transformations from the coarctate larval stage all take place within the unrent larval skin.—We have:

2d—The more spinous and larger triungulin of the still more prolific *Meloë*, with long caudal setæ, but otherwise closely resembling that of *Sitaris* in the femoral, tarsal and trophial characters, in the subequal thoracic joints, in the unarmed tibiæ, and in the instinctive love of light and fondness for fastening to bees. The second larva is also mellivorous, but the later transformations take place in the rent and partly shed skins of the second and coarctate larvæ.—We have:

[1] The larva of *S. humeralis* appears to differ from that of *S. colletis* in having hairs on the femora and tibiæ.

3d.—The larger and much more spinous triungulins of the less prolific *Epicauta*, *Macrobasis*, and *Henous;* with unequal thoracic joints, powerful mandibles and maxillæ, shortened labrum, slender femora, well-armed tibiæ, slender, spine-like, less perfect tarsal claws—combined with an instinctive love of darkness and tendency to burrow and hide in the ground. The second larva takes the same food as the first, its skin is almost entirely cast from the coarctate larva, while the subsequent changes are independent and entirely free of the shell of this last.

Larval Habits of Cantharis.—The question naturally arises here, whether *Cantharis*, in its larval habits, will most agree with *Meloë* and *Sitaris* or with *Epicauta*. The triungulin, except in becoming almost black, has much in common with *Meloë*, in the subequal thoracic joints, and the long antennæ; also in its habit, observed by Lichtenstein, of fastening to bees.[1] The fact that it can nourish on honey, though it does not appear to do so freely, would also indicate that it breeds in the nests of solitary bees. Nevertheless, in the slender thighs and the caudal and abdominal characters it agrees more nearly with *Epicauta*, and in the stage following the first molt the legs are still quite long and the general aspect much like the carabidoid stage of that genus. I should not be surprised, therefore, if *Cantharis* also nourished on locust eggs.

What is Known of the Larval Habits of other Meloid Genera.—*Mylabris* Fabr. (*nec* Geoff.), according to V.-Mayet, is much less prolific than any Meloids so far observed. The egg is 2.5 mm. long and is ½ as wide, with a tolerably thick shell and the embryo more fully bent within it. The triungulin has many of the characters of *Epicauta*, judging from the published description (*Ann. Soc. Ent. de Fr.*, 1876, p. cxcvi.), which is, however, not sufficiently detailed as to the trophi. I doubt not that the genus will be found to infest locust eggs.

Horia Fabr., from what little is known of it, would seem to have a similar partial parasitism to *Meloë*, but on carpenter bees.

Tetraonyx Latr., was found by Guérin-Meneville in places frequented by bumble-bees.

The eggs of *Apalus* Fabr., as well as its triungulin, are said to resemble those of *Meloë*.

Zonitis Fabr., is known to develop in the cells of *Osmia* and *Anthidium*, and to have a coarctate larva much like that of *Sitaris*.

[1] Since this was published M. Lichtenstein writes me: "They only fasten to bees when enclosed in tubes with them. At liberty they do not climb flowers, like *Meloë*, in search of bees, but run quickly on the soil, just as you describe for *Epicauta*."

THE SIRENIA.

BY ARTHUR E. BROWN.

AS the name of this curious order of aquatic mammals was suggested, without doubt, by the probability that they, in great measure, gave origin to the ancient myths regarding the existence of sirens or mermaids, it may not be inappropriate to take a first look at the animal as it appeared to a sailor of Capt. Weddell's Expedition towards the South Pole, about the close of the first quarter of the present century. "The sailor had lain down and about ten o'clock he heard a noise resembling human cries; and as daylight in these latitudes never disappears at this season, he rose and looked round, but on seeing no person he returned to bed; presently he heard the noise again, rose a second time, but still saw nothing. Conceiving, however, the possibility of a boat being upset, and that some of the crew might be clinging to some detached rocks, he walked along the beach a few steps and heard the noise more distinctly, but in a musical strain. Upon searching round he saw an object lying on a rock a dozen yards from the shore at which he was somewhat frightened. The face and shoulders appeared of human form and of a reddish color; over the shoulders hung long green hair; the tail resembled that of the seal, but the extremities of the arms he could not see distinctly. The creature continued to make a musical noise while he gazed about two minutes, and on perceiving him it disappeared in an instant."

Notwithstanding the fact that the sailor testified his belief in his story by making a cross in the sand and kissing it, we who look on the manatee and dugong, with minds cleared from a delusive belief in mermaids and mermen, are tempted to agree with Capt. Weddell in the last clause of which he makes use in relating the circumstance: "I concluded he must really have seen the animal he described, or that it must have been the effects of a disturbed imagination."

Naturalists, however, have had almost as much trouble, in times past, to determine where these animals structurally belong, as the old explorers had to decide whether they were forms of earthly or supernatural origin. They were classed in the old order *Pachydermata* on account of their points of resemblance to the elephant; then they were put with the whale and the porpoise in

the *Cetacea*, and they are now generally regarded as an independent order, known as *Sirenia*, allied more closely with the Ungulates than with any other living mammals; they—the vegetable eaters of the sea—being doubtless descended from some form of terrestrial Herbivora, as the Seals, Whales, etc.,—the aquatic Carnivores—probably claim parentage among the terrestrial Carnivora.

The earliest Sirenian known to Palæontology is the *Halitherium*, found in the Miocene formation of Central and Southern Europe. Those now existing are separated into two genera,—*Manatus* and *Halicore*, and, generally speaking, there is a strong resemblance between all members of the group.

They all possess a cylindrical body tapering towards each end from a point just in advance of the middle; the tail is flat and horizontal; the hind limbs are entirely wanting; the fore limbs are placed far forward on the breast and are covered with integument like the rest of the body; the nipples are two in number, and, as in the human species, are situated on the breast; the neck is thick and is not separated by a well drawn line of demarcation from either the head or the body; the head is rather small and round, the lips being thick and fleshy; the eyes are round and of small size and the nostrils, situated on top of the extreme end of the snout, are closed with a valve; the presence of an ear is only to be recognized by a sort of crease in the skin; the hide, in appearance and toughness, much resembles galvanized rubber and is covered very scantily with stiff bristles an inch or two long, these are so sparsely scattered, however, that it requires a close inspection, almost, to see that they are there,—around the lips and mouth they are longer and more plenty and are deserving almost of the name of whiskers. In these characters all the Sirenians agree.

The two genera composing the order are, however, recognizable at a glance, and the species into which they are divided, though closely allied, yet present characters which are held to be sufficiently distinctive for the recognition of two species of dugong and three of manatee.

The one genus, *Manatus*, is found altogether in the waters of the Atlantic Ocean, with the single exception of a small part of the East coast of Africa, north of the Cape of Good Hope, while the other genus, *Halicore*, is strictly confined to the South Pacific and Indian Oceans. No species are found in the Northern

Hemisphere much beyond lat. 30°, and they are common in the greatest numbers in the equatorial and warmer temperate zones.

Manatus latirostris is found in San Domingo and other parts of the West Indian Islands, on the Atlantic coast of Florida and sparingly along the Gulf of Mexico, down to the neighborhood of Honduras, where it gradually merges into *Manatus australis*, which follows the northern and eastern coast of South America to lower Brazil, reaching not much beyond the 20th degree of south latitude.

Crossing the South Atlantic, *Manatus senegalensis* is first found on the western coast of Africa, about the upper part of Senegambia, from which point it ranges southward along the Atlantic coast, around the Cape of Good Hope and up the east coast as far as the Mozambique Channel. Here the first representative of the dugongs, *Halicore dugong*, makes its appearance, about where the last species ends, and ranges up the east coast of Africa, along both shores of the Red Sea and the southern coast of Asia as far as Cochin China; taking in Borneo and the leading islands of the Indian Archipelago lying to the westward of the Straits of Lombok, which marks strictly the boundary line between the Indian fauna and that of the Australian region. The one remaining species, *Halicore australis*, ranges along the northern shore of Australia and down the eastern coast of that continent, which is washed by the waters of the South Pacific, to about latitude 30° south. It was stated by Hernandez that he had found an animal supposed to be either *H. dugong* or *H. australis* on the coast of Peru and Ecuador. Individual members of the order have also been seen on several occasions in the neighborhood of the British Islands; it is probable that these belonged to *M. latirostris* and that they were transported by the Gulf Stream from Florida or the West Indies. It is thus seen that the polar extremes in range of the *Sirenia* are about the 30° of latitude, north, in the United States, and the 35°, south, at the Cape of Good Hope.

They live generally about the mouths of rivers and are even found up the streams to a considerable distance from the coast, rarely being common in water of more than several fathoms depth. It is stated also that in Africa they inhabit fresh water lakes near the coast,—this is not, however, beyond dispute and is doubtful, except by supposing a water communication with the main sea. All are strictly herbivorus, feeding on the water plants which grow in great profusion in the localities which they frequent.

The manatee rarely attains a length of more than eight to ten feet. The tail, like that of the dugong, is horizontally placed, but differs from that species in being evenly rounded on the end; the fore extremities are short and weak; the fingers are enclosed together in one fold of integument and bear faint vestiges of nails; the skin is thick and very tough and of a lead or slate color. There are no incisor or canine teeth in the adult, and the molars are thirty-eight in number,—twenty in the upper and eighteen in the lower jaw. These are not all present, however, at any one time, as they successively come out, fill their purpose and are succeeded by others in turn. The bones of all the Sirenians are massive and heavy; the animals, therefore, possess little buoyancy in their native element and are not much disposed to rapid motion.

The main points of difference between *M. australis* and *M. senegalensis*, according to Prof. Owen, are in the larger skull of the former and in the conformation of the malar bone and of the mandible or lower jaw. *M. latirostris* is said to resemble the African form more closely than it does its nearer neighbor on the American coast.

Several efforts have been made to keep the manatee alive in confinement, but without much success. One of the most satisfactory attempts was made in the summer of 1876, by the Zoölogical Society of Philadelphia, and as the habits of the animal are not very widely known, a few words descriptive of the manner in which this specimen passed its time may not be uninteresting.

The animal was a female, not fully adult, about six feet long, and was captured in the Orinoko river. She was put in a tank containing about a foot of water and was shipped from Demerara in May, arriving in Philadelphia on the 15th of June, apparently uninjured by the tossing to which the vessel had been subjected during the voyage. She was at once placed in a glass tank containing about forty-five hundred gallons of water, at a temperature of about 75 degrees,—the weather being warm, this was about the natural degree, and only once while the animal lived was it necessary to heat the water artificially to keep it at this point.

The great difficulty was to get it to feed. The ship captain who brought it up, said, "Oh! there is no trouble about that, it will eat anything," and insisted that he had been feeding it on ship-biscuit and cabbage, but when this was tried, the ship-biscuit

might as well have been cobblestones and the cabbage had about as much effect as a piece of rag carpet, so it was tempted with all the delicacies of the season in the way of vegetables, in the hope that something more easy to obtain than river grass might prove acceptable, but nothing would do, so a variety of sea-weed and aquatic plants were placed at its disposal: sedge grass, *Myriophyllum* and *Sagittaria* were to be had in large quantities, but did not seem to be exactly the thing, until at last a variety of *Potamogeton* was found which the animal took to at once and in a month it had eaten all there was in the Schuylkill and Delaware rivers within reaching distance of Philadelphia, and it became necessary to give it something else—generally *Sagittarias*, of which it ate the heads—while a new crop was growing up. It was remarkable to see with what dexterity the animal, though seemingly deficient in all the senses, would pick out the stalks of its favorite food from among a wheelbarrow load of stuff thrown into the tank. In this it appeared to me to be guided more by its sense of smell than by sight,—which agrees perfectly with the observations of Dr. H. C. Chapman, Prosector of the Society, on two specimens which had previously been kept in the garden, and also with the result of his dissection of those animals, which showed that the olfactory nerves were well developed.

The manner of introducing food into the mouth appeared to be peculiar; the upper lip being chiefly used, and that by a motion rather lateral than downwards. The lip is fleshy and tumid, incapable of much mobility and is cleft in the centre, like a hare lip, and the motion seemed to be produced by muscular contractions, drawing the sides inward and toward the cleft, bringing into play the bristles with which they are clothed, almost as organs of prehension.

It was difficult to observe this action, as the animal seemed to be somewhat nocturnal and fed at night; the water also became discolored by the mud which adhered to the plants, and the animal, when feeding, quickly became obscured to view.

It had been stated that the manatee was in the habit of crawling partly out on the bank for the purpose of obtaining food; as it did not seem probable that the animal could move to any extent on land, considering the weakness of its fore-limbs, this was tested in the following manner: A shelf was arranged gently sloping at an angle of about 30° from one side of the tank so that its

lower edge was under water, this was covered with wisps of straw so as to bear some resemblance to the sloping bank of a stream covered with sea-weed left by the ebbing tide. As the animal did not seem disposed to put even its nose on the shelf, its food was for some nights deposited there, just above the water line, with the result that it did not show the slightest disposition to help itself, until after some hours the grass was thrown into the tank, when it at once fed. It never manifested the least trace of a desire to raise itself out of the water, and certainly no structure could be worse adapted to move on land than the awkward bulky body and the weak flippers of the manatee.

The animal was never in good condition from the earliest period of its confinement, and was very apt to become costive, which was always relieved by throwing some soft river mud into the tank, which it swallowed with excellent effect. It appeared to be very fond of mud, and was always more lively when the water was discolored by heavy rains than at any other time. In general, through the day time it rested on the bottom of the tank, on its chin and the end of its tail, with the body slightly arched. Every two and a half minutes on an average, using its tail as a pivot, it raised its head to the surface by the action of its fore flippers, just so that its nostrils appeared above the water, and after taking breath sank at once to its former position at the bottom. Although sluggish and inactive in habit, the animal was not devoid of intelligence; it learned to recognize its keeper, and soon appeared to understand that no harm was intended when the water was drawn off from the tank for the purpose of cleaning. At such times, after the first few days, it lay perfectly quiet on its side, and allowed the keeper to sweep around and over it without making the least disturbance.

The animal lived a quiet unruffled existence, apparently as happy in its tank in a corner of the Carnivora House as it could have been in its natural home. Everything was done for it that it apparently could desire—a palace of glass kept clean without the least trouble to itself, clean water made brackish as that of its native haunts by a solution of marine salt, and carefully watched by the aid of a thermometer lest the cold air of the north should be too trying for a constitution accustomed to the warmth of the equator; plenty of that food which it selected as being best adapted to its wants, and in fact all that the most assiduous care

could suggest and procure, but liberty is liberty, and the waters of the Schuylkill were not those of its native Orinoko, and so after two days of extreme torpor and indisposition to eat, she was found on the morning of September 5th, resting on the bottom of the tank, having died as she had lived, peacefully, and with no more exertion than could by any possibility be avoided.

A careful post mortem examination revealed the presence of a large quantity of a fatty deposit about the region of the heart, exactly as had been the case in two specimens which had previously been kept in the Garden, and as it does not seem possible that accommodations more in accord with the native surroundings of the animal could be given in confinement and in so different a climate, or that the attempt could be made at a more favorable season of the year, it appears almost certain that the speedy death of these animals was owing to insuperable obstacles in the way of acclimating the species here. It is possible that the more northern member of the group, *M. latirostris*, which occasionally experiences a touch of frost in the St. Augustine river in Florida, and is presumably more hardy than those from more southern regions, might be better adapted to a residence in this latitude, but I do not know that the opportunity has ever been fully presented for the experiment. A pair of this species was at the Garden for some days in the month of August, 1876, but as the Society did not care to pay the large price demanded for them, they were removed by their owner to one of the Centennial side shows, where they were destroyed by a fire before they had been here long enough to give any indications as to how they were going to adapt themselves to the climate.

The dugongs grow to a larger size than the manatees, *Halicore dugong* being sometimes twenty feet long; their general appearance is similar, the tail, however, instead of being rounded is forked, and their color is bluish on the back, running into dirty white beneath. The alveolar process of the pre-maxillary bone is much elongated and bent downwards, giving the animal the appearance of having a nose of a very pronounced Roman type, and causing the mouth to open rather downwards.

There are two incisor teeth in the upper jaw of the adult male, and none in the lower jaw; in the female there are no incisors visible, their growth being arrested before they emerge from the socket. The number of molars varies in different individuals

according to age; it is stated that the full number in the adult dentition of *H. australis* is twenty-four, and twenty in *H. dugong*.

The habits of all the sirenians, so far as is known, are essentially similar, the dugong as well as the manatee being found around the mouths and up the water courses of the coast.

This order affords a most striking instance of the discovery and speedy extinction of a species, the *Rhytina borealis*, or *stelleri* of some authors, having been discovered on Behring's island in the sea of Kamschatka, by one of Behring's exploring parties, which was shipwrecked there in 1741. They existed in large numbers, were easily killed, and during the ten months which the shipwrecked party spent on the island, sad havoc was made among the animals. They were rapidly reduced in numbers, and in 1768, twenty-seven years after they became known to civilized man, the last one was killed. Almost all that is known of the living animal is from an account published in 1751, at St. Petersburg, by Steller, who was one of the discovering party, and who saw it in its native haunts.

The *Rhytina* was about twenty-five feet long, had a forked tail like that of the dugong, and was covered with a rough, wrinkled, brownish hide nearly an inch thick, composed of hair-like tubes agglutinated together into a substance somewhat like horn, and of so great toughness that it scarcely yielded to a blow of an axe. The adult animal was entirely devoid of teeth, and had in their stead a rough horny plate on the front of the palate, to which was opposed a similar one on the lower jaw.

The *Sirenia* are of considerable value to the natives of the countries which they inhabit; the hide is of use for making a thick leather, and the flesh is much esteemed for the table. It is said that the church, disagreeing with nature and science, determines that the manatee is a fish, and therefore the good Catholics of South America feast royally on its flesh on Friday and all other fast days.

AN EXAMINATION OF PROF. LEO LESQUEREUX'S THEORY OF THE ORIGIN AND FORMATION OF PRAIRIES.

BY O. P. HAY.

FOR many years past there has been no lack of literature on the subject of the prairies of the western states and territories, nor any dearth of theories to account for their origin. We have had their existence ascribed to fire and to water; to heat and to cold; to all sorts of phenomena and to the lack of them. The forests that once clothed these regions must have been burned up by prairie fires—before the prairies existed. They must have been drowned out by the waters of vast inland lakes that once covered these prairie states. They must have been parched up up by the dryness of the climate. They must have been smothered by the impalpable fineness of the soil in which they grew. They never had an existence; because the seeds which ought to have produced them must have been ground to pomace by the glaciers of the Age of Ice, or hopelessly buried beneath their *débris*.

Prof. Leo Lesquereux, eminent in both recent and fossil botany, has published various papers on this subject, the latest of which appears in Vol. I. of the Illinois Geological Survey. In subsequent volumes of this excellent Survey this paper is frequently referred to; and certain phenomena observed in various portions of the state by the members of the survey corps, are cited as helping to establish Prof. Lesquereux's theory. As this scientific work will have a wide circulation amongst geologists; and since, on account of the high reputation of Prof. Lesquereux as a scientist, his opinions will have great weight in determining people's opinions concerning an important geological feature of the West, it is proposed in this paper to examine the grounds upon which the theory has been based, and to test its correctness. For the writer believes that the theory is insufficient to account for all the facts involved—is, indeed, opposed by many of them; and that those examples which have been cited by the geologists as confirming the theory, instead of so doing, are excellent proofs of the way in which prairies have *not* had their origin.

Prof. Lesquereux believes the failure of forest vegetation to occupy the praries to be due to the chemical nature of the soil, coupled with, as it would seem from his language, its exceeding fineness. He believes that all our prairies and Western plains, as well as the plains of South America, Europe and Asia, have been

formed as we may now see prairies of far less extent being produced along the shores of the lakes of the West and along the banks of rivers. "Where the waves or currents strike the shores or the low grounds and there heap material, sand, pebbles, mud, etc., they build up more or less elevated dams or islands. These dams are not always built along the shores, but often enclose wide shallow basins, whose waters are thus sheltered against any movement. Here the aquatic plants, sedges, rushes, grasses, etc., soon appear, these basins become swamps, and, as it can be seen near the borders of Lake Michigan, though the waters may surround them, the trees never invade them, never grow upon them, even when the swamps become drained and dried by some natural or artificial cause." Prof. Lesquereux states that such marginal swamps, generally fringed with trees, can be seen also along the shores of Lake Erie, and along the Mississippi and Minnesota rivers, outside the line of slack water. All gradations are to be found between such swamps and dry prairies. He hence concludes that all our prairies, not only the low prairies along our lakes and rivers bottoms, but also the high rolling prairies, have been produced by the slow recess of sheets of water of various extent; that these lakes have first been transformed into swamps and by and by drained and dried. The soil of these ancient swamps, having been produced by the slow and incomplete decomposition of aquatic plants, must be of impalpable fineness and thoroughly impregnated with ulmic acid; the former condition proving deleterious to the germination of the seeds of trees, the latter condition favoring the growth of the peculiar vegetation of the prairies.

But if the prairies were at one time swamps, why is their surface not now everywhere level, or nearly so? Or, if the existing elevations have been formed as low islands or dams in lakes, why are they not now wooded? Mr. Lesquereux believes that the surface was originally horizontal; but that it has been made to assume its present undulating character by the slow and long continued erosive action of water;—in short, that the broad, gently sloping valleys have been worn out by running waters as have the beds of our rivers and creeks; the difference being that in the former case the waters have had a very gentle, in the latter a more rapid motion.

Let us now consider the facts and argument presented by Prof. Lesquereux, to sustain his opinion.

And first, is it true that trees will not, as a general thing, grow in swamps, or in ground that has once been a stagnant marsh? That there are but few species of trees that will grow in swamps covered with stagnant water none perhaps will deny; but that these same swamps will not, after they have been drained and dried, allow the growth of arborescent vegetation remains to be proved. All of Prof. Lesquereux's arguments and citations of authorities in reply to Prof. Winchell's objections to the theory of excessive moisture, cover but this one point, viz., that trees will not grow on lands saturated with stagnant water, and leave unproved the other and most important statement that they will not grow there when the ground has become dry. Should this statement be true, we ought to find extensive prairies in many regions where prairies are rare; for instance, along our low Atlantic coast, and the delta of the Mississippi River. Especially ought we to expect to find such tracts along the Amazon, instead of finding there the densest forests on the globe.

Long ago, in the American Journal of Science, Prof. Dana, in writing on the origin of prairies, gave the results of his own observations made in the Mohawk valley, and cited observations made by Prof. Verrill in Maine and Labrador. In this article it is stated that in Maine the bottoms of the lakes are, near the shores, composed of black, soft, vegetable mud of great depth; and though sedges and rushes are found growing at the water's edge, various kinds of trees approach very near the shore, growing even where the supporting soil is soft and wet. In cases where lakes and bogs have been drained, although grasses and sedges may get the mastery the first year or two, forest trees afterward gain the ascendency and keep it. In Labrador, trees were found growing in peat bogs, in the very borders of lakes and pools of stagnant waters. If trees will grow in stagnant marshes and on peat bogs in Maine and Labrador and are not found growing in similar situations in the Mississippi Valley, some other explanation of the fact must be sought than the chemical nature or the fineness of the soil.

But I believe that even in the Mississippi Valley we shall have no difficulty in finding luxuriant forests in situations where, according to Prof. Lesquereux, we ought to find only prairies; nor difficulty in finding prairies where we should be led to expect to find abundant timber. The soil of the Mississippi flood-plain has been deposited as in the case of other large rivers. In some

places strong currents have washed together coarse sands and gravels; in others, where the water has had a gentle movement, it has deposited only the finest sediment; the greater portion of the bottoms, however, consists, as we might expect, of a mixture of these materials, enriched by the humus from decaying vegetation. There has been no lack of opportunities for the formation of swamps in these bottoms, which are frequently from four to eight miles or more in width. Nevertheless, on these bottom lands, formed to a great extent in the way described by Prof. Lesquereux, and much more recently than can be claimed for the higher prairies, we find the heaviest growth of timber and the greatest proportion of timber land.

In the southern part of the State, where upland prairies do not exist, the flood-plain is clothed with the densest growth of forest trees; and this almost irrespective of the character of the soil. In Alexander county, for instance, as stated in the Report of the Illinois State Geological Survey, "the bottom lands are generally flat and are interspersed with cypress ponds and marshes." The higher bottoms are said to be heavily timbered with various kinds of trees. "The swampy lands are characterized by the growth of the cypress, sweet gum, tupelo gum, cottonwood, pecan, willow, etc." We find analogous statements made concerning the counties lying northward along the Mississippi, until we reached the region where prairies begin to appear on the highlands. Then small prairies appear also on the flood-plain; but these are likely to occupy the higher grounds and the dense timber growth the low wet lands. We learn of heavy forests on soil described as a deep sandy loam, highly charged with humus; and on similar soils, bottom prairies. Nor is it unusual along the Mississippi and other rivers of Illinois to find bottom prairies whose soil contains a large proportion of sand and gravel. In the report of the geology of Jo Daviess county, the most northern river county of the State, we find this statement: "In the western part of the township of Hanover, bottom timber-land, alluvial grass-land, and a table-land, high and dry, exhibit all the characteristics of the ordinary Mississippi alluvial bottoms. Farther down in Carroll county this bottom changes into the broad, well-known sand prairie, an old, broadly extended, glittering Mississippi sand-bar." Such quotations from many independent observers could be multiplied indefinitely to show: 1st. That even marshes may be timber-grown; 2d. That the distribution of forest lands bears

no relation to that of ancient swamps; 3d. That sandy and gravelly bars and dams are frequently devoid of trees.

But even if we should grant all that Prof. Lesquereux claims respecting the inability of trees to thrive in soils that have accumulated in swamps, I cannot admit that his theory will explain the occurrence of prairies over a large part of Illinois and Iowa. However it may be in the case of Wisconsin and Minnesota, it is evident that the soil of the prairies of at least large portions of the former States has not been formed in marshes. We have, it is true, evidence that at some period since the epoch of the Drift the surface of the whole country has been depressed much below its present level. We find everywhere along the Mississippi River and at many points along the Illinois an extensive deposit capping the bluffs and sometimes extending out into the ancient river bed. This deposit is sometimes very thick near the bluffs, but thins rapidly towards the highlands and soon disappears. This deposit, called in the Report of the Illinois Survey the Loess, must have been thrown down during the Champlain epoch, when a series of lakes occupied the broad valleys of our rivers, filling them, no doubt, to their brim, and even extending over portions of the surrounding country. But that the prairie soil or subsoil was then deposited, or that there has been any general submergence since, we have, I think, no sufficient reason for believing.

On the contrary there are many serious objections that might be urged against the idea that the prairie soil has been deposited in lakes and stagnant swamps; some of which I shall here present.

1. According to Lesquereux, timber is found growing along dams cutting off from the body of the lake the bog that is to become prairie. Do we find our Illinois forests on the higher lands? That they sometimes so occur, especially in northern Illinois, will not be denied; but in such cases, instead of being long stretches of timber, bordering and separating prairies, they are generally small, rounded clumps. Much the greater part of the wooded country in Illinois is found along the river bluffs and on the bottom lands.

2. If the prairie soil is a lacustrine deposit, it ought to be free from such coarse materials as are found in the Drift. In swamps whose soil has been produced by the decay of vegetation and from sediment washed in by gently flowing waters, there is scarcely a possibility for coarse rocks and boulders to occur. The discovery of a large Drift boulder in the alluvium of the Missis

sippi river, in Whiteside county, was regarded by the observer as so extraordinary as to call for a special explanation. And yet on the prairies of Illinois, frequently lying on the surface and in the soil at all depths, are found numerous boulders of granite, syenite and trap rocks. On the surface they are found scattered from the hilltops to the very borders of the sloughs; and hidden in the ground they frequently prove a nuisance to the cultivator of the soil. Their presence in such situations cannot be reconciled with the notion that the soil is a lacustrine deposit.

3. The general absence of fossils in the soil and subsoil of the high prairie lands is opposed to Lesquereux's theory. In the Loess we find abundant fossils of land and fresh water shells. Such remains, too, sometimes occur in the deposits of the sloughs and marshes on the prairies; but these deposits are of later date than the soil of the higher grounds, and have frequently been formed as described by Lesquereux. If the prairie soil had been formed as he supposes, it would have afforded the most favorable conditions for the preservation of animal and vegetable organisms. "At a depth of from one to three feet the mosses, confervæ, and charas form a thick carpet which hardens, becomes consistent, like a kind of felt, and floating about six inches above the bottom, is nearly thick enough to sustain the weight of a man. This carpet is pierced with holes where fishes pass to and fro; and the bottom under it is that fine impalpable clay, evidently a residue of the decomposition of its plants." We ought then almost anywhere on these prairies, to find insect and leaf beds as rich as those of Œningen. But where now are those aquatic insects that people such waters; those land and fresh water mollusks; those numerous cray-fishes; those leaves of plants that must have been buried there? Where are now those little fishes that passed to and fro through the holes in that mossy carpet? So far as the writer knows, no such remains have been found.

4. The theory urged by the distinguished botanist requires us to suppose that these prairies have undergone a greater amount of denudation than would have been possible under the conditions supposed. He admits that the prairies must originally have been horizontal, and attempts to explain their present undulating character by supposing that where we now find broad and level sloughs, the soil has been removed by the gentle movement of water on its way to lower levels. The hills, however, rise frequently many feet, sometimes perhaps a hundred, above the level of

the low grounds, and these may be many rods in width. The theory under consideration requires us to believe that in such cases an enormous amount of material has been removed. And yet it is questionable whether, under such circumstances, the soil would be removed as rapidly as it would accumulate through the decay of vegetation. For if the surface were as level as we must suppose it was, and as it frequently is in these sloughs, the water must have moved so slowly as to carry little sediment along with it; and as the water passed through the tangled grasses, rushes and sedges, even this little would have been filtered out.

Indeed, the cause assigned for the uneven surface of the prairies is one that tends to produce the very opposite effect, that of removing any inequalities of the surface that might have at first existed. For the water running down the hillsides would have carried with it some soil. On reaching the level slough its velocity would have been checked and a large part of its burden deposited. That this has occurred, rather than the contrary phenomenon, is plainly shown by the fact that the alluvium is much deeper in the sloughs than on the tops and sides of the hills.

5. The theory referred to requires us to ascribe to the alluvial deposits of the hypothetical lakes an undue thickness. For, since the peculiar fine soil of the prairies is found on the hilltops, as well as in the valleys between; it follows that, if the surface were once level, the lacustrine deposit of soil must have been of a thickness at least equal to the height of the hilltops above the lowest point to which the soil extends in the valleys. We must then believe that the deposit was perhaps a hundred feet in depth; and since the valleys have been scooped out of this, we might expect to find the hills composed entirely of the lacustrine sediment—rich, black, prairie soil from ten to one hundred feet in depth. On the contrary the soil is comparatively thin on the hilltops, very deep in the valleys.

The valleys have been excavated from the Drift formation; and the general contour of the prairies must have been determined before the prairie soil was formed, under whatever conditions it may have resulted. That some portions of the prairies, especially those bordering our great lakes and some of our rivers, have originally been swamps cannot be doubted; but that they are destitute of trees must be attributed to other causes, the absence of which in other localities permits the growth of trees alike on the finest or the coarsest, the sweetest or the sourest soil.

METHODS OF LABELING IN OÖLOGICAL COLLECTIONS.

BY W. H. BALLOU.

THE study of the eggs of birds, which has recently taken such impetus as to give it a recognized position in the science of ornithology, is at present in a condition deplorable indeed, from its broad deficiencies in the matter of labeling. Taking up an egg, in size no greater than a robin's, we find plentifully scattered over its surface an advertisement large enough to adorn a newspaper column, spreading forth the fact apparently of great moment to the scientific world, that Mr. So-and-so was the fortunate collector of the egg, that it was collected on such and such a day, month and year, that it is a certain number in a standard catalogue, and numbers so-and-so in So-and-so's collection. Examining European eggs in countries where the science was old when America was new, specimens are often found with a semicircular band of paper, or with a square label pasted on them with the scientific name written in ink or printed. Where the names are long, it is often a matter of speculation as to which occupies the greater space, the egg or the name. It is a shocking disgrace to European oölogy, equal in some respects to the eminently unscientific usages of our own oölogists. It is astonishing that during these centuries of existence that the science has attained so little eminence, and has remained so deficient in so small a matter as labeling, leaving out other points of greater and of less moment. It has heights and depths which it may attain to, and which will undoubtedly be arrived at before many years. Its devotees, at present, seem to consist mainly of a class of persons whose only interest is concentrated in the knowledge of having a "collection" of eggs and in discovering species yet unknown. The latter though of value to oölogy are used to build up ornithology, and to that science is the credit of the discovery given.

In consideration of some of the above facts it has been a subject of much study on the part of myself and undoubtedly others as to what remedies may be successfully applied to so great an evil as the present labeling system. The problem is not without its difficulties of solution. Many and varied were the experiments tried, which sometimes met with success in part, but on the whole are causes of grave errors. In each experiment some one was sure to so disarrange the eggs as to make it impossible to identify them. A leading difficulty was also found when

the collector possessed one or more sets of the same kind, or large quantities of eggs of the same species, as in the case of water-birds. It is still worse, when each egg or set of eggs of the same kind was obtained on the same day under different circumstances and in different localities. Here there should have been a separate label in each case; but what collector is there that has been able or disposed to furnish one, or if he has done so, who at his death will be able to decipher them? A catalogue of continued difficulties rises before the collector; labels pasted, or markings written on the egg, deface portions of its natural colorings. Slender shells often crumble in the hand while attempting to inscribe a written narrative thereon. Eggs are exchanged, passed into a new collector's hand, who rubs away at the original marking, and deprives it of its natural luster and finish to make way for a new and more extended announcement. Drawbacks of these descriptions are sufficient to place any science below par and cast suspicion on its accuracy.

But at last an expedient has been determined upon which, if followed, seems to cover the entire ground and to keep each individual egg forever in a condition that will enable one to preserve an accurate record of it.

Having occasion during the past year to make an arrangement of the collection of oölogy in a certain Academy of Sciences in the west, my attention was more than ever drawn to the absolute necessity of having a different system of labeling from the one I employed there, especially in so large an institution where duplicate eggs are stored away by the thousand with no distinction whatever. Soon after obtaining additions to my own collection of eggs, some of which required mending, I was attracted by the wonderful adhesive force of "coaguline"[1] in cementing shells together. Following out the line of thought presented at the time, I was enabled to perfect a system of labeling which is essentially described here:

Slips of paper are to be prepared in triangular form, or at least to have one portion tapering to a point as in Fig. 1. The slips

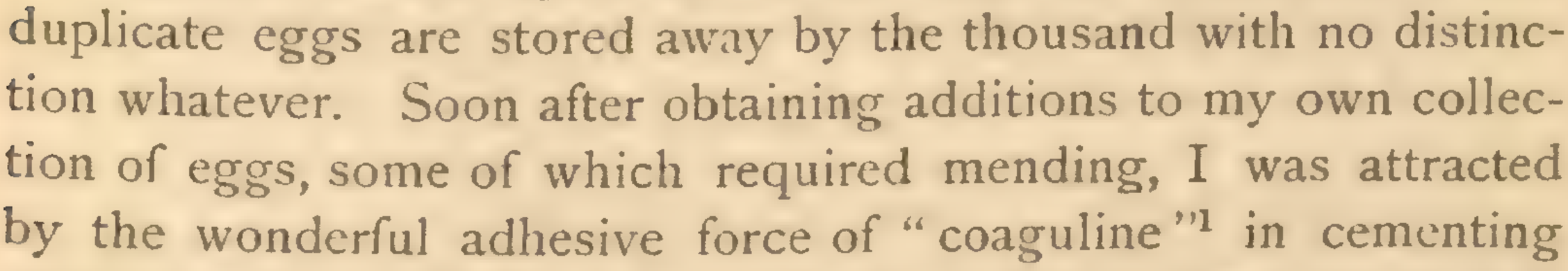

FIG. 1.

[1] A preparation sold by druggists.

can be cut in sizes varying with the dimensions of the eggs, or the amount of writing intended to be placed upon them. Having made the necessary record, the very tip of the label may be moistened with coaguline and fastened to the egg as in Fig. 2. It should be placed on the border of the drilled hole on the side, so that both may occupy as little space as possible. Almost the entire surface of the egg is now in a condition for examination. The advantages of such a label are seen at once. Both sides may be written upon. They may be used as handles by which to hold the egg for examination, thus saving many eggs from being crushed. They may be made sufficiently large to contain all necessary writing, or small enough to suit the taste. They may be taken off at any time by simply dipping the cemented portion into warm water; and it is often desirable to do this, especially in exchanges. There is no possible danger of their being torn off when they are handled with the care usually bestowed on eggs.

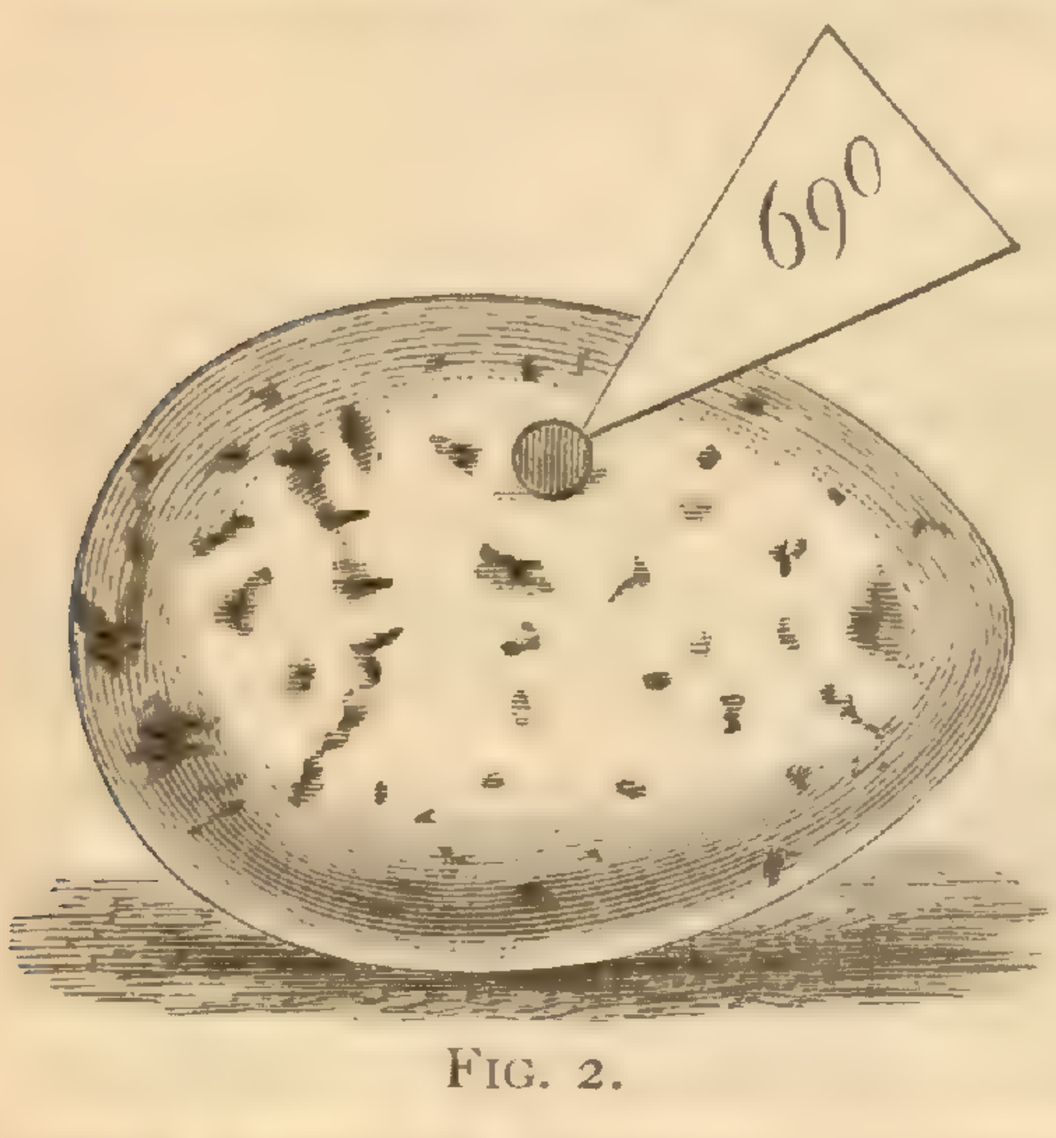

FIG. 2.

A practical use of the above method is convincing proof of its efficiency.

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NOTES ON INDIAN MANNERS AND CUSTOMS.

BY DR. EDWARD PALMER.

The Navajoes in the presence of death.—In 1869, Colonel Dodd, agent of the Navajo Agency, was very sick, and Barboncito, the head chief, though quite unwell himself, went to see him. After gazing intently upon the Colonel for a few minutes, and shaking hands, the chief said in Navajo, "I wish you a good journey," and left the room weeping. When the agent was dead and laid out, all the Indians came to look on him whom they had loved so well, though it is their custom never to look upon the dead. At the funeral Barboncito expressed a desire to go with the Colonel, but afterwards recovered from his sickness.

A Navajo Indian being sick, his friends took away his ticket entitling him to food at the Agency, gave him an old blanket and

some water, and left him to die. No coaxing or threats of the agent could induce them to go near the corpse, and it was buried by the men of the Agency. The custom is, upon the death of a member of the tribe, to block up the door of the hut containing the corpse and never again to visit the spot through fear of evil spirits. They sometimes kill the best horse of the deceased and eat it at a funeral feast.

Navajo women gambling.—The Navajo women are fond of gambling, which they practice in the following manner. A square, marked off and surrounded by small stones, is divided into four equal parts, having ten stones to each part. A large flat stone is placed in the centre, and a stake four or five feet long is firmly set at each corner of the space. A blanket is stretched over the square and fastened to the stakes, but not to shade the players, as will be seen. At each of the four divisions of the square a player is seated on the ground, while young and old stand or sit around to enjoy the sport. Three short, flat, smooth pieces of wood, black on one side and white on the other, are used to play the game. The player takes the sticks in the right hand like jack-straws, and, bringing one end forcibly upon the stone, sends them up against the blanket which causes them to fall into the square. If three black sides are up, it counts five, if white, ten. If one white and two blacks are up it counts two, if two whites and one black, three. Each player keeps tally by scratching a notch on a stick with a stone. They are very fond of the game, manifest great spirit in playing, and will frequently stake all they have upon it.

Apache playing cards.—The Apaches now use in gambling a pack of cards similar in shape and ornamentation to those used among civilized people. They are made of horse hide, tanned separately, and painted with the juices of wild plants. Like the Mexicans these Indians will sit upon the ground night and day, and in all weathers, gambling with an excitement amounting almost to frenzy, and stopping only when the stakes or their strength is exhausted.

An Apache Medicine-man.—The medicine-man of the Ararypa band of Apaches is called Tseiland. He wears a very noted hat which could not be purchased at any price, owing to the belief that it came from the sun, and that to part with it would gain the sun's displeasure. The hat is made of buckskin and ornamented

with turkey and hawk feathers, buttons, shells, and turquois. It is never off his head, night or day, excepting for a short time when he is washing his hair or combing it. The fingers of an Apache answer for a comb, being drawn through the hair, while the head is bent a little to one side.

Apache rat-catchers.—The Apaches, old and young, hunt rats, with long crooked sticks, no hole being too deep or winding, no brush too thick or thorny for them. The entire animal, just as caught, is roasted, and before half cooked is devoured, entrails and all. It is amusing to see a party of young Apaches returning from a hunt, with rats dangling at their belts as thickly as they can hang. No dyspepsia disturbs these juvenile rat-catchers, no cat or terrier can equal them in dexterity.

Apache marriage.—After the female consents to be a bride, the bridegroom must get the permission of her father, who at the same time names the articles to be given in exchange for her. The groom delivers the goods and takes his bride, not to his house, however, for she must build and equip that, and procure a great portion of the food for the family. The life of an Indian wife is one of incessant and severe drudgery. Adultery is considered a great crime on the part of the wife, but public sentiment does not condemn the husband. As soon as the crime is proved, the unfortunate female is captured and her nose cut off close to her face, leaving a horrible wound which is not healed for a long time. For months some wear rags around their faces to hide the scar, and they conceal themselves from strangers.

Visit to the Moqua Indians.—In May, 1869, in company with the Rev. Vincent Colyer, I visited the Moqua Indians. One night, when camping near one of their towns, we wished some corn for our horses. The Governor being informed of the fact mounted the top of his house and called aloud for corn. A movement was soon discernible, house-tops, windows, and doors were occupied by listeners. The Governor repeated his call several times. Soon from every quarter corn was brought in flat baskets, until more than enough was procured, for which we were to pay nothing, but Mr. Colyer gave them some flannel. They were surprised to see us giving corn to our horses, because it is raised with so much difficulty that they use it only for their own consumption.

The governors of the Moqua towns are accustomed to mount

their house tops at night and to give instructions to the people regarding the labors of the following day. The night before we left the town of Uriba, one of these harangues was made, and we were informed that the governor had instructed his people to go out early in the morning and kill off the jack rabbits, which would otherwise eat up all their corn. Early next morning all the men turned out, accompanied by the women, whose business it was to take care of the game. Rabbits are an important article of food with these Indians, and the skins cut up into strips are made into cloaks and beds. The implement used in capturing them is the boomerang, which is shied at the legs of the animal. The captain of the same town once ordered the people out to capture the rats in the corn-field.

The Governor of Uriba invited Mr. Colyer, Lieut. Krouse, and myself, to dine with him in his three-story house. He received us cordially, showing us a silver headed ebony cane, the gift of President Lincoln. Dinner being announced, a blanket was spread on the floor, and upon it were arranged dishes of dried peaches, a good supply of mutton, and a large basket of corn-cakes as blue as indigo, made from the meal of the blue corn. There were also some dishes filled with a sweet liquid made by dissolving the roasted center of the agave plant in water; coffee completed the bill of fare. There were neither plates, knives, forks, spoons, or napkins, but the dinner looked clean, and so did everything else about the house. The bread answers for both plate and spoon. You take a small piece, lay a fragment of mutton and some peaches upon it, or a little of the sweet liquid and bolt the mass, spoon and all. This dinner, though prepared and cooked by Indians, tasted better than many a meal eaten by us in border settlements, cooked by whites. After dinner we took leave of the Governor with many thanks.

Eating customs in several tribes.—The Cocopah Indians of Arizona will not eat pork, though they have acquired a taste for salt beef. They are very fond of fish and will eat them at any time. They will not eat shell-fish of any kind. The Mono Lake Indians of California, eat soup made of angle-worms thickened with grass-seed flour. They also gather bats from caves and roast them in hot ashes without removing either feathers or entrails. Wasp nests are roasted and eaten; the more young they contain the better are they relished. The young Indians, in order to find the

nests, capture a wasp, place a small straw in the abdomen, light it, and let the insect go, they then watch its flight, follow it, and secure the nest. The Miama Indians were very fond of a dish prepared by boiling the roots of the yellow lily, *Lilium canadense*, with meat. In the fall the roots, often two inches in diameter, are gathered; they taste very much like green corn. These Indians also eat otter oil cooked in soup, and consider it very nutritious.

The Cheyennes and Arapahoes consider dog-meat a superb dish, and when they wish to honor a guest especially, they kill the fattest dog and roast it; great offence is given if the guest eat not bountifully of the chosen dish. They also eat poisoned wolves in the Buffalo country. The white men kill the buffaloes for their hides, tallow, tongues, and some of the best portions of the meat. The tongues bring a high price. The rest of the carcass is then poisoned with strychnine. The wolves eat the meat and their intestines become inflamed, producing death. The Indians remove the viscera and eat the remaining portions of the wolf. On Cow Creek in Kansas, in 1865, I saw the carcasses of hundreds of wolves that had been thus eaten.

The Wichita and Comanche Indians will not eat fish that have scales, but are fond of those that have no scales; they catch both kinds, and sell those which they do not like to the whites.

The Apaches kill the beeves issued to them in the following manner: They divide themselves into parties; a lasso is cast around the animal's horns and he is thrown to the ground. His throat being cut, a number of the Indians mount the body, still alive, while the others proceed to cut up the animal in spite of his plunging. I saw on one occasion a party cutting out the ribs, another removing the viscera, when the beast with a fearful bellow, extricated himself from the piles of Indians holding his legs, dealt one man a terrible blow in the face, and gored another in the stomach. But they rushed like wolves on their prey and soon had the quivering meat dangling at their horses sides, the squaws carrying off every morsel that was left. In this operation the strong have no respect for the weak, animals that have been sometime dead are not rejected, and every part of the carcass is devoured. They greatly prefer mule and horse flesh. It is roasted half done, all standing around and cutting off slices as soon as it is thoroughly warmed. They will not eat anything, however, that has been killed by lightning.

The Navajoes dislike pork, but they beg for it to soften leather. They do not eat bear's meat, and to call a man a bear is a term of great reproach. They do not eat eggs for fear that they will hatch in their stomachs. Turkeys also are rejected because they think that bad white men, after death, are changed into that bird. The transformation occurring beneath the water, the white markings in the feathers of the turkeys is due to the white foam. These Indians capture the turkeys and sell them to the whites.

While staying at the Navajo Agency I poisoned a number of mice for specimens and laid them away until an opportunity offered for skinning them; but hardly was my back turned, before they were stolen and cooked.

Prairie dogs are a favorite article of diet with the Navajoes. The animals are caught thus: A piece of glass is fixed in the split end of a stick which is so placed as to throw the light into the hole. The animal as he amuses himself at the glass is a good mark for the Indian. Another method is to place a large stone above the hole with a string attached; when the prairie dog goes off to feed, the string is pulled and the stone dropped over the mouth of the den. The dog returning and finding his door blocked up, commences to dig around the stone, when he is quickly pinioned by the hunter's arrow. The Navajoes mix their meal or flour with water, and pour the batter into a hole made in hot ashes where it is left to bake.

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RECENT LITERATURE.

A VALUABLE WORK ON THE HONEY-BEE.[1]—This little French work before us is worthy of translation, so as to make its contents accessible to that large and growing class of bee-keepers who have mastered the technology of bee-keeping as practiced in this country. While it is eminently scientific, it is not above the comprehension of an ordinary reader. We notice particularly the full discussion of the embryology and anatomy of the drones, queens and workers, a subject not usually treated as fully as it deserves. The enemies and diseases to which this wonderful insect is subject are also described and the former also figured. The geographical distribution of the three domestic forms of the

[1] *Les Abeilles, Organes et Fonctions Éducation et Produits Miel et Cire.* Par MAURICE GIRARD, ancien President de la Société entomologique de France, etc. Avec une planche coloriée et trente figures dans le texte. 12mo, VIII, pp. 280. Paris, 1878. J. B. Baillière et fils.

bee are given, viz: the common black of Central Europe, Italian and the Egyptian, which is also found in Asia Minor, and supposed to be the species spoken of in the Bible. The systematic position and relations of the creature also receive attention.

In describing the apparatus used in their management, we notice that most of it is such as has been thrown aside and superseded in this country by simpler or more effective contrivances. The "queen yard" as used by Quinby and improved by Mrs. Farnham, "queen cages," "breeding hives" are not mentioned. This fact taken with what the editors saw at the Centennial Exposition in the way of apparatus, from England principally, leads him to conclude that American bee-keepers are far ahead of their European brethren in the perfection of appliances to render the pursuit of apiculture profitable.

BREHM'S ANIMAL LIFE.[1]—This volume completes the account of the Carnivora, and treats of the Insectivora, Rodentia, Edentata,

FIG. 1. SKELETON OF THE KANGAROO.

[1] *Brehm's Thierleben.* Band 2. Grosse Ausgabe. Zweite umgearbeitete und vermehrte Auflager. Leipzic, 1877. 8vo, pp. 628. B. Westerman & Co. New York.

Marsupialia and Didelphia, so that some of the most interesting of all the mammals are described by word and pencil. The vol-

FIG. 2. KANGAROO (*Macropus thetidis*).

ume is rich in full page illustrations, containing fifteen drawn with

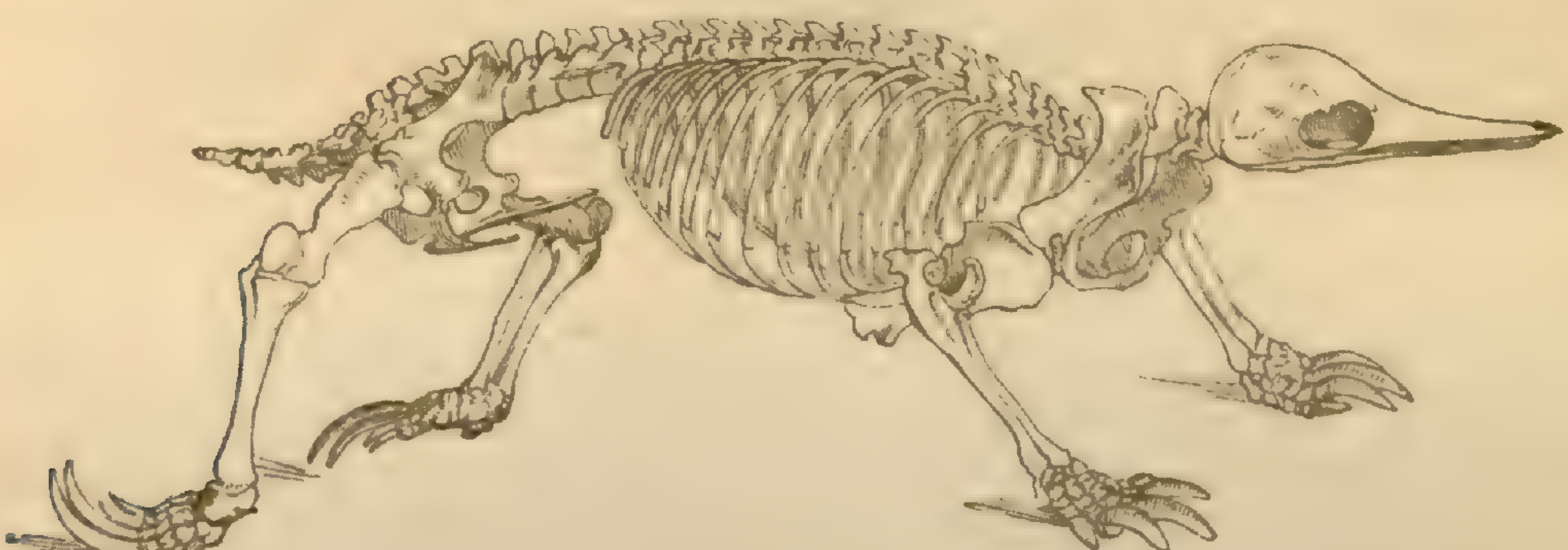

FIG. 3. SKELETON OF *Echidna hystrix*.

great apparent accuracy and skill, comprising portraits in various

attitudes, with the appropriate surrounding features, or environment, of the crag and long-lipped bear, hyæna, ichneumon, coati, bobak, mara or cavy (*C. patagonica*), fish otter, field mouse, porcupine, with a very spirited drawing of a drove of capybaras, and a group of kangaroos, as well as the singular Oryctopus of the Cape

FIG. 4. SPINY ECHIDNA (*E. hystrix*).

of Good Hope, and the two-toed sloth (*Cholæpus didactylus*). The marsupials are illustrated, with many excellent drawings, including among others pictures of the Thylacinus, tasmanian devil, Dasyurus, opossum, kangaroo rat, wombat, koala, &c., &c. Through the kindness of the publishers we are able to reproduce the skeleton

of the kangaroo, and a drawing by Zimmermann of *Macropus thetidis* (one-eighth natural size). The Monotremes are also well drawn, as will be seen by the accompanying figures of the *Echidna hystrix*, and its skeleton; the pair of duck-bills is well drawn.

The bears are well figured with one or two exceptions. We are not well suited with the group of prairie dogs, and in the account of them more perhaps might have been quoted from American authors, than from passing German travelers. The Egyptian Jerboa is well drawn and described at length, while no mention is made of our American jumping mouse or *Meriones hudsonicus*, and our characteristic jackass rabbit is not mentioned, much less figured. Still the work is of great value to the general reader and student of nature, as well as the special zoölogist, as being a treasury of excellent illustrations and descriptions of the habits of the most striking animals of the globe; and we hope that the work will meet with a good sale in this country, where we are too much inclined to study American species alone. The price of the work in this country is 40 cents a part or about $5.00 a volume, which is certainly very reasonable.

RECENT BOOKS AND PAMPHLETS.—The Development of the Cranial Nerves in the Chick. By A. Milnes Marshall. (From Quart. Journ. Microscopical Science) 1877. 8vo, pp. 33. Two plates.

Brehm's Thierleben. Leipzig, 1878. New York, B. Westerman & Co. Band 7. Parts 1-10. 40 cts a part.

Ferns of North America. By Prof. D. C. Eaton. Salem, S. E. Cassino. 4to. Parts 2 and 3. $1.00.

Collembola borealia. Nordiska Collembola, beskrifna af Tycho Tullberg. (Ofversigt af Kongl. Vetenskaps Akademiens Förhandlingar, 1876). Stockholm. 8vo, pp. 19. 4 plates.

Estudios sobre las Deformaciones, Enfermedades y Enemigos del Arbol de cafe en Venezuela. Por. A. Ernst. Caracas, 1878. 8vo, pp. 24.

Note sur des Perforations, observées dans deux Morceaux de Bois fossile. Note sur une aranéide fossile des Terrains tertiaires d'aix. Par. Charles Brogniart. (Extrait des Annales de le Société Entomologique de France). Paris, 1877. 8vo, pp. 9.

Notes on the Herpetology of Dakota and Montana. By Drs. Elliott Coues and H. C. Yarrow. (Extracted from the Bulletin of Hayden's U. S. Geological Survey of the Territories, iv, No. 1.) Washington, 1878. 8vo, pp. 48.

Nomenclature in Zoölogy and Botany. A report to the American Association Adv. Science. By W. H. Dall. Salem, 1877. 8vo, pp. 56.

Pacific Coast Lepidoptera, No. 24. Notes on the genus Colias, with descriptions of some apparently new Forms. By Henry Edwards. (From the Proceedings of the California Academy of Sciences. February 5, 1877.) 8vo, pp. 11.

Annual Report of the Entomological Society of Ontario for the year 1877. By W. Saunders, C. J. S. Bethune, B. Gott and J. Williams. Toronto, 1877. 8vo, pp. 59.

Beiträge zur Kenntniss der Anatomie von Chiton. 8vo, pp. 27. Ueber den Begriff der Segmente bei Wirbelthieren und Wirbellosen, nebst Bemerkungen über die Wirbel. Säule des Menschen, 1877. 8vo, pp. 4.

Report on the Geographical and Geological Survey of the Rocky Mountain Region. By J. W. Powell, Washington, 1877. 8vo, pp. 19.

Notice of the Butterflies collected by Dr. Palmer in the arid regions of southern Utah and northern Arizona during the sunimer of 1877. By S. H. Scudder (Extracted from the Bulletin of Hayden's U. S. Geological Survey of the Territories. Vol. IV, No. 1). Washington, 1878. 8vo, pp. 6.

Notes on some Jurassic Fossils, collected by Mr. G. M. Dawson, in the Coast Range of British Columbia. By J. F. Whiteaves, Montreal, 1878. 8vo, pp. 10.

Traveling notes on the Surface Geology of the Pacific Slope. By G. M. Dawson. (From the Canadian Naturalist, viii. No. 7.) February, 1878. 8vo, pp. 11.

GENERAL NOTES.

BOTANY.

INFLUENCE OF MOISTURE ON VEGETATION.—Carefully conducted experiments (published by Paul Sorauer in the *Botanische Zeitung*, Jan., 1878) with spring barley yielded the following results: In dry air branching was greater than in moist, the mean figures standing at 2.77 and 2.37 respectively; length of leaves was greater in moist air in the ratio of 21.37 to 21.07, but the breadth was less (6.74 to 7.33); a moist atmosphere is more favorable to length of leaf-sheath in the proportion of 9.26 to 8.18, to growth of the principal stem (13.5 to 11.5) and to root development (26.8 to 23.9). It was found that the epidermal cells of the leaves were more numerous and broader, the cells between the stomates shorter, and the stomates themselves shorter in dry air. Also, that leaves developing in a moist atmosphere have comparatively fewer stomates per millemetre of length. The question is worth further working out *apropos* of the relation between the minute structure of organs and their environment.—*Journal of Botany.*

BESSY'S INJURIOUS FUNGI.—This is an essay on the different species of blight or Erysiphei, which live chiefly on the leaves and sometimes on the stems of plants, and attack no less than fifty species of plants of much value in agriculture. The article contains descriptions of all but three species, the descriptions in a few cases being original. Figures of ten species in sufficient detail for their identification accompany the text, which is extracted from the Seventh biennial report of the Iowa Agricultural College.

VARIATIONS IN THE LEAF-SCARS OF SIGILLARIA AND LEPIDODENDRON.—In two papers reprinted from the Annals of the New York Academy of Sciences, Mr. H. L. Fairchild gives some interesting results of studies showing that species of these fossils have been multiplied to too great an extent, from the imperfect nature of the fossils, owing to the great variability of the only characters that can be used by fossil botanists.

REINSCH'S SAPROLEGNIEÆ AND PARASITES IN DESMID CELLS.—While this article from Pringsheim's Yahrbuch contains observations on certain new and very curious low plants, its chief interest to us are the figures and descriptions of sundry cytodes which have the power of penetrating the interior of desmids, and remind us of certain monera described some years ago by Cienkowski under the name of Vampirella.. The author, who has just gone to Key West to study the large one-celled algæ, has lately, during a visit to this country, been engaged in a study of the organisms in the Cochituate water of Boston. He found over a hundred species of minute plants and animals in this excellent drinking water.

Botanical News.—In the London *Journal of Botany* M. A. Hartog describes the floral structure and affinities of *Sapotaceæ*. W. P. Hiem discusses a question of botanical nomenclature. C. C. Babington contributes Notes on *Rubi*, and there are several descriptive papers.

At a late meeting of the Linnæan Society, F. Darwin read a paper on the Nutrition of *Drosera rotundifolia*, in which he showed the advantage gained by the plant being fed with meat, and that the capture by the plant of flies is of similar benefit.

Mr. T. Dyer made a brief communication on the so-called "rain-tree" of Moyobamba, North Peru. This tree promises to excite as much interest amongst residents in hot, dry countries as the supposed anti-malarious properties of the fever tree (*Eucalyptus globulus*) had done amongst the inhabitants of hot dry ones. From information received through Mr. Spence, it seemed probable that the rain tree was *Pithecolobium saman*, and the so-called "rain" the fluid excretions of homopterous insects which fed on the juices of the foliage; other trees, however might become rain trees, and the phenomena were comparable to the production of honey dew from the lime, etc., by the agency of Aphides.

ZOÖLOGY.[1]

The homology of the Chevron bones.—The chevron bones of *Reptilia* and *Mammalia* have been regarded as the homologues on the inferior side of the vertebral centrum, of the neural arch on the superior side. However this may be true of fishes, it appears not to be the case in the two classes named, in an exact sense. I have recently determined the fact that the basal portions of the chevron bones are continued throughout the greater part of the vertebral column in the Permian genera *Clepsydrops*, *Metarmasaurus* and *Epicordylus*, forming intervertebral elements to which I have given the name of intercentra. This intercentrum nearly replaces the centrum in *Trimerorachis*, and does so completely in *Rhachitomus*, both Permian genera. In *Cricotus* the intercentra are subequally developed with the centra, producing the curious appearance of two kinds of vertebral bodies alternating with each other, the true centra only bearing neural arches, and the intercentra bearing chevrons in the caudal region. It appears then that the chevron bones are the remnants in the caudal vertebræ of a structure once general throughout the column of air-breathing *Vertebrata*, but which has been replaced in them in the dorsal and lumbar regions, by the true centrum. The free elements of the cervical series of some reptiles are probably the same.—*E. D. Cope.*

[1] The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

NOTES ON THE RECENTLY DESCRIBED MONOTREMES.—With the appearance of Gervais' *Osteographie des Monotremes Vivant et Fossiles*,[1] zoölogists are again reminded that not all that is to be known in regard to beings now living has yet been chronicled. This memoir follows close upon Mr. E. P. Ramsay's papers read to the Linnæan Society of New South Wales. In the two we get materials which very greatly enlarge our knowledge of these curious porcupine-like animals with anteater-like tongues, of which the best and longest known example is *Echidna hystrix*. Mr. Ramsay describes a form apparently belonging to the old genus, which he calls, *E. lawesii*, from Port Moresby, New Guinea; the number of nails being the same as in the old species, viz: five, both in front and behind; but I find upon comparing a skin of *E. hystrix* with his drawings that the inner nail is apparently somewhat longer in his species. He observes that the species "is distinguished chiefly by the long cylindrical form of the quills, and the stiff, flat hair-like bristles on the face." It is unfortunate that the describer has not ascertained the number of palatal corneous processes on the tongue and also the cranial and osteological differences which would have done much to establish the legitimacy of the species.

The new *Acanthoglossus bruijnii*, monographed by Prof. Gervais, measures about 19 inches in length, or about one-half longer than the species hitherto described. The occiptal condyles are much more prominent backwards than in *Echidna*, and the beak is about three times as long as in the latter, and curved slightly downwards. On the palatal membrane there are a series of conical corneous processes depending into the oral cavity; these are in five transverse rows of from four to eleven, at the posterior nareal extremity; then in twos, then a single one, then a pair, then in symmetrical clusters with transverse toothed borders. There are seventeen of these rows, individual and clusters of corneous retroverted processes in *Acanthoglossus*. Gervais says that in *Echidna* there never was more than seven of these series; Owen corroborates this, saying (*Anatomy of Vertebrates* vol. iii, p. 385), "The palate is armed with six or seven transverse rows of strong, sharp, but short retroverted spines." The posteriorly convergent lines of spines on the basal portion of the tongue in *Acanthoglossus* furnished a further distinction from *Echidna* in which these are in a confused cluster. The four transverse fimbriated lamellæ in front of this cluster of spines, as in *Echidna*, are absent. The tongue itself is about two and a-half times longer than in the old species, the basal two-thirds cylindrical, tapering and vermiform, but not acuminate at the tip, being rounded at the end and grooved on the dorsal face for about a third of its length. In the groove there are three longitudinal rows of backwardly directed spines, a median and two lateral.

[1] Bertrand. Paris, 1877-78,

The cerebral portion of the brain of *Acanthoglossus bruijnii* is more pointed, while that of *Echidna*[1] is more obtuse and somewhat square in outline anteriorly when viewed from above. The cerebral convolutions of the former are more numerous and complex than in the latter, where they are relatively few and simple.

The interclavicular bone supports a strong median carina much more prominent than in *Echidna*. The xiphoid segments of the sternum in *Acanthoglossus* are ossified and not cartilaginous. The phalanges of the manus and pes of both genera may be represented as follows:—

Acanthoglossus, manus 1,3,3,3,2; pes 1.3,3,3,2; ungues $\frac{3}{3}$.
Echidna, " 2,3,3,3,3; pes 2,3,3,3,3; " $\frac{5}{5}$.

The foregoing characters which are the principal ones, justify, it would seem beyond all doubt, the propriety of erecting the large New Guinea species into a separate genus as Gervais has done. Knowing, as we do, the exceedingly trivial and insufficient morphological differences which have served for the establishment of new genera and species, we can readily appreciate such wide differences as are here presented principally in the number of phalanges and nails, as well as perhaps the more important lingual, palatal, cranial and cerebral characters.

The specimens, a male and female, upon which Prof. Gervais has based his genus, were brought by M. Leglaize from the northern part of New Guinea to Paris. They were obtained on the Karon mountains, at a elevation of 3770 feet above sea level. Peters and Doria had previously described the skull of this species and called it *Tachyglossus bruijnii*.[2] The natives call the animal *Nokdiak*.

The known species of monotrematous spiny anteaters are accordingly three, provided *Echidna lawesii* is distinct, which it appears to be from the rather brief and hardly sufficient description of its author; and *E. hystrix* and *E. setosa* are identical. The species then stand as follows in the order of discovery, or rather of characterization:

Echidna hystrix Cuv.
E. lawesii Ramsay.
Acanthoglossus bruijnii Gerv. —*Jno. A. Ryder.*

Prof. P. E. Schulze has discovered the mode of development of the European cavernicolous *Proteus anguinus*. He found one at Adelsberg cave which had laid fifty-six eggs, very similar to those of *Siredon pisciformis*. The *Proteus anguinus* is proved by researches on the ovary of a female from which the eggs were taken to be oviparous.

[1] Nouv. Arch. du Mus. Tom. 5, Pl. 14, fig. 16, p. 248.
[2] Ann. del Mus. Civ. di Sci. Nat. di Genova, tom. IX Dec. 3, 1876.

ANTHROPOLOGY.[1]

MODERN MOUND-BUILDERS.—The Tualati tribe of the Kalapúya stock, living near Forest Grove, the Yampill tribe formerly occupying the valley now called the Grande Ronde Reserve, Yampill and Polk counties, Oregon, and probably all the Kalapúya tribes of the Willámette valley are accustomed to invoke the celestial powers by working themselves violently into a state of utter exhaustion. They roam all night without eating, put themselves into a sweat and leap into a cold river, and scale high mountains to see the sun rise. At the appearance of the god of day they exclaim "O, I am poor! O, I am poor! Make me rich! Make a chief of me!" (The chiefs being the wealthiest men in the tribes.) During the night they throw up with their hands little mounds from three to seven feet long and from twelve to eighteen inches high. Their design is not to conceal property or to bury the dead, but simply to work themselves into a terrible sweat. Their exertions often occupied five nights, the wandering about without food being kept up during the day. These little hillocks are ever after kept in repair. They are erected principally by girls on their first menstruation, by parents who have lost children, by others after bereavements, and by young people generally who thus expected to obtain riches by dreaming of eagles and other good portents. These tamanowus dreams are regarded very highly among them.—*Albert S. Gatschet.*

THE THIRD VOLUME OF CONTRIBUTIONS to North American Ethnology, published by the Department of the Interior, under the editorial charge of Major J. W. Powell, is a positive addition to our ethnological literature, and demonstrates the wisdom of the Smithsonian Institution in committing the publication of its linguistic material to its present hands. The first portion of the volume is by the veteran explorer, Mr. Stephen Powers, first introduced to the literary world by Mr. H. H. Bancroft in his Native Races, and contains an exhaustive account of his researches among the California tribes. The preface contains a rather severe blow at Major Powell's pet theory about the sparseness of Indian population on our continent, the publication of which is a tribute to the fairness of the Major as well as to the independence of Mr. Powers. The latter part of the work is occupied by vocabularies, in the collection of which Major Powell is especially engaged.

ANTHROPOLOGICAL NEWS.—The Davenport, Iowa, *Daily Gazette* of February 16th, contains the description of another carved slate tablet, found in No. 11 of the Cook Farm group, from which the cremation tablet was taken last year. It is about seven and a-half by 12 inches, and has on one surface a human figure sur-

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

mounting an image of the sun. In the upper corners are facsimiles of bird-pipes, and in the space between the pipes and the human figure occur various hieroglyphics and the figure of a copper axe. The indefatigable industry of the Davenport archæologists has more than once received the commendation of this journal, they will therefore receive a word of caution with kindness, and not allow themselves to be duped by some wag who will throw discredit upon the discoveries for which we are indebted to Messrs. Gass, Farquharson and others.

The Hon. N. E. Dawson, of Burlington, Ohio, presented to Congress, Feb. 5, a memorial on a Reformed Alphabet and Orthography.

Keith Johnson will publish a compendium of Geography and Travels, one volume to be devoted to each continent. The work will be similar to Von Hellwalds' "Die Erde und ihre Völker."

An Ethnological Museum opened at the Hotel des Invalides, Paris, contains a collection of papier maché warriors of all times and peoples, civilized and uncivilized, in order to exhibit in one view the history of the destructive agencies employed by man.

The Sociétié d' Anthropologie has arranged for a series of "Séances pleniéres internationales des Sciences anthropologiques," in connection with the anthropological exhibit at the Paris Exposition. The paper read will be published in a separate volume.

An Archæological Society has been organized in Japan, called Kobutzio-Kai (Society of Old Things). H. Von Siebold, a member of the Society, has opened a mound at Ozmuri near Jeddo, containing over 5000 articles in stone, bronze, &c. Mr. Siebold says that prior to the Christian era it was customary to surround the grave of a deceased king or queen with a number of attendants, buried alive to the neck. Subsequently clay images took the place of the living subject, and numbers of these images are found in old grave yards.

Mr. Frank Cushing has made a very interesting discovery in connection with the pottery recently sent from the shell heaps of Japan by Prof. Morse. Comparing the marking on this pottery with the ornamentation upon a collection of Aino clothing, previously sent to to the National Museum by Hon. Horace Capron, Mr. Cushing finds the constant recurrence of a conventional pattern on both, to wit, a series of elongated hexagons, joined at their apices, and filled with ornamentation which resembles hatching in a wood cut. This marking is produced on the pottery by the impression of a coarse bast cloth, and on the clothing by embroidery. This seems to indicate that the makers of the shell-heaps were the ancestors of the Ainos.

The following papers on American Anthropology have been noticed: Grönland und seine Bewohner, II., *Ausland*, No. 2; Vom Amazons und Madeira, Dr. Robert Lallement, Gaea, I.; Entdeckung der Statue eines Itza-königs in den ruinen von Chichen. —Itza, *Ausland*, 4.

Attention is called to the following titles of foreign works and papers: The Evolution of Morality, J. Staniland Wake, Trübner; On the Origin of Reason, Max Muller, *Contemp. Rev.*, Feb.; Forest and Field Myths, W. S. Ralston, *id.*; March of an English Generation through Life, *Quart. Review*, Jan.; Evolution of Ceremonial Government, Herbert Spencer, *Popular Science Monthly*, Feb.; Ueber das Alter der Hohlenbewohner des Schaffhauser Juras, Dr. J. Nuesch; Studien zur Völkerbewegung in Mitteleuropa, Dr. Mehlis, *Ausland*, 1877, 52, 1878, 4; Wohnsitze der Deutschen in dem von Tacitus in seiner Germania beschriebenden Lande., Dr. H. Böttger, Stuttgard, 1877; Morphology of the human teeth as related to the races of men, Dr. E. Lambert, reprint in *Amer. Journal*, Oct., 1877; On the subjection of the old by the young, Carus Sterne, *Kosmos*, July, 1877; On the speech of primitive man, Fraulein von Hellwald, *id.*; The origin of the culinary art, Fritz Schultz, *id.*; On the color sense, Hugo Magnus, *id.* Aug.; The Darwinian philosophy, with reference to the problem of will, &c., *id.* Sept.; Color and color sense, Prof. Jäger, *id.*; The language of primitive man, Dr. F. Weeland, *id.* Oct.; Die Forschungen der Kaiserlichen archäologischen commission zu St. Petersburg, II, III, in *Mittheil. d. Anth. Ges. in Wien.*, 7, 8 and 9; Review of Cesnola's "Cyprus," *Academy*, Jan. 19; Cutturgeschichte des Orients unter den Chalifen, Alfred von Kremer (Band II reviewed in *Academy*, Feb. 2, by Stanley Lane Poole); Die Orientalische Frage als cultur Frage, F. von Hellwald, *Ausland*, 1, 2, 3, 4; Languages of farther India and the Indian Archipelago, with map, *Geographical Magazine*, Feb.; Ein Samoa Dorf, *Ausland*, 2; Ueber die Perforation des Penis bei den Malayen, A. B. Mayer, *Mittheilungen Anth. Gesellschaft Wien.* 1877, No. 9.

GEOLOGY AND PALÆONTOLOGY.

The Structure of Coryphodon.—I observe in the issue of "*Nature*," No. 435, p. 340, a note by Prof. O. C. Marsh, stating that I have included in the cast of the olfactory lobes of the brain of *Coryphodon* that of a part of the nasal cavity also. Prof. Marsh fails to point out the qualifying remarks to be found in my descriptions. In the explanation of Plate I of the Proceedings of the American Philosophical Society, 1877, p. 620, I say, "the right bulbus of the olfactory lobe is probably too large above, owing to the want of preservation of the superior wall of the cavity." In my quarto report to Lieut. G. M. Wheeler, in vol. iv., p. 223, of his report to the Chief of Engineers, I remark: "In excavating the matrix from the olfactory chambers some difficulty was experienced in attempting to lay bare the superior and inferior walls, etc. On one side of the bulb this boundary was probably passed through, giving a larger vertical diameter than

the true one." There is no doubt, however, that the greater part of the cast of this region, which I have made, belongs to the olfactory lobes, and for the following reasons: The excavation was conducted with the greatest care, occupying more than two weeks, and the sandy matrix was removed grain by grain. No transverse cribriform plate was found, and no osseous body interrupted the matrix posterior to the anterior extremity of the chamber cast. No longitudinal septum divided the olfactory chambers until the entire thin edge which marks the fundus of the groove in my figure[1] was reached. It is not probable that these structures had been present and been lost. The position of this chamber is much posterior to that of the nasal cavities in *Mammalia* generally, being above the posterior part of the pterygoid plates, instead of between the posterior (tapir) or anterior (hog) regions of the orbits. The septum observed is doubtless that which divides the right and left olfactory lobes. Its sides are smooth as far as the inferior termination of the chamber as figured. I have not followed out its superior extremity owing to the appearance of delicate osseous pieces which may belong to the ethmoturbinal. This is the *first interruption* of the olfactory chamber met with. What the homology of the contents of this space with the olfactory lobes and nerves of later mammalia may be, remains to be ascertained.

Prof. Marsh's last paper on this family is, however, not free from what I should call, were I to use his phraseology, "glaring errors." He denies that the ectocuneiform bone is in contact with the astragalus, which is palpably the case (see my Fig. 12, Pl. LIX, in the volume iv, Palæontology of the U. S. G. G. Survey under Lieut. G. M. Wheeler). He also represents the temporal fossæ as converging towards a sagittal crest behind the orbits, which is not the case. The temporal fossæ are entirely lateral as in *Uintatherium*. See my Plate LII of the work cited. Rather, however, than assume that these are "glaring errors," I await solution of the question as to whether two different genera of *Pantodonta*, i. e., *Bathmodon* and *Coryphodon* are not under consideration.

Prof. Marsh's statement that I am "perfectly familiar" with the contents of a paper published by him in the spring of 1878 is also erroneous. I have not thought it necessary to read that paper, since in his paper of 1877 he merely repeats my own discoveries without credit. My work on this genus commenced in February, 1872, and everything known of it in addition to the subject as left by Hèbert, was added by myself between that date and the spring of 1876. In April of that year I exhibited to the Academy of Natural Sciences of Philadelphia, and a few days after to members of the National Academy at Washington, the cast of the brain of this genus. Prof. Marsh's paper appeared after

[1] Wheeler's Report Pl. LI, Figs. 2–6.

my first exhibition of it, being an extra sheet of the May number of the *American Journal of Science and Arts.*—*E. D. Cope, Philadelphia, March* 20, 1878.

THE ORIGIN OF LAKES.—Prof. Ramsay, F.R.S., Director-General of the Geological Survey, gave the Monday evening lecture at the London Institution on "The Great Ice Age." He commenced with a description of a typical Swiss glacier, drawing special attention to that which is commonly called the perpetual snow line, here some 8,500 feet above the sea level, which is called perpetual rather by courtesy than as being an absolute fact. While it is the snow which furnishes the mass of the glacier, the fragments of rock carried down originate in this way: There are some steep slopes which are not covered with snow, and are exposed to the heat of the sun. The alternating heat during the day and the cold of the night cause disintegration, and masses of the rocks are broken off, which not only form the heap of rubbish called moraines, but some of which, falling through the crevasses, form the "graving tools" which score the mass of rock beneath into grooves. If we look further afield, we find glaciers in the Himalayahs, in Greenland, and in Victoria Land which make those of Switzerland appear quite insignificant. In Victoria Land the sheets of ice which float off are of enormous thickness, and indicate through what a severe glacial period the Southern Hemisphere is passing. The chief signs by which the former existence of glaciers in places where they no longer flow can be traced, are the old moraines and the scratchings on the rocks. Taking these as guides, the eye of a trained glacialist can detect with certainty the traces of long-departed glaciers in many parts of the world. The well-known examples in Wales were first mentioned, and then in succession those of Scotland and North England were described. There is evidence in Scotland that in former times the glaciers were so extensive that part flowed out through the Frith of Forth, part through the Frith of Clyde, and part over the table-land of the Lammermoor Hills. Cumberland at one time was smothered in glacier ice. The glaciation of Anglesea was the result of a different system from the glaciers of Wales, as is proved by the fact that the striations of the rocks lie in different directions. The Scandinavian mountain chain has been unmistakably moulded by glacier action, and there are abundant evidences that North America has been intensely glaciated. These facts had been noticed by many observers, but there was a point in connection with this which Prof. Ramsay said he claimed as his own idea, and that was with regard to the origin of lake basins. His belief is that in all cases they have originated from glaciers—that is, that the basins have been scooped out by glaciers. He pointed in confirmation of his position to cases in many parts of the world where there are lake basins near

mountain chains which could have furnished glaciers, and that lakes are absent in districts where there are no high chains. He did not, however, say that there were not some which had originated from other causes. The lecture was illustrated by diagrams and water-color drawings.—*London Times.*

(While glaciers have undoubtedly modified mountain valleys, which existed in mountain chains long before the glacial epoch, it is the opinion of many who have had large experience in glacial studies, that the agency of glaciers in scooping out lake-basins is much exaggerated. Many glacial lakes are due to streams being dammed by old moraines.—EDS. NATURALIST.)

A NEW FAUNA.—Prof. Cope has recently made an examination into the Permian formation of the west, of which a fragment was found by Dr. Winslow, in Illinois, a few years ago. He finds this period to have been rich in life, chiefly in *Reptilia* and *Batrachia.* Two remarkable genera of saurians have been discovered, in which the long diameters of the crowns of the teeth are transverse to the axis of the jaws. In one of these, *Diadectes* Cope, the teeth are flat, like those of the pharyngeal teeth of *Catostomidæ;* in the other, *Bolosaurus* Cope, the crowns are bulbiform with an apex on one side, and a deep notch on the other side. *Diadectes sideropelicus* and *Bolosaurus striatus* and *B. rapidens* are the known species. *Clepsydrops* has been found to have the canine and incisor teeth distinctly characterized. The ischia are immensely enlarged in an antero-posterior direction, forming a boat-shaped body. The neural spines of the lumbar and sacral regions are greatly elevated, indicating a fin like that of *Basiliscus.* Two new species are described, *C. natalis* and *C. gigas*, the latter of the size of the larger *Mammalia. Epicordylus* has vertebræ like those of *Clepsydrops*, but the neural spines are all club-shaped. The typical species is *E. erythroliticus*, which is as large as an alligator. The most remarkable form is *Empedocles*, which has a few characters which especially characterize the genera of the Dakota Cretaceous, *Camarasaurus* and *Amphicælias.* These are the hyposphen and hypantrum articulation, and a transversely thickened neural spine. The zygapophyses are greatly elevated, and are connected with each other and the diapophyses by a wide expansion. The only species is *E. alatus*, whose vertebræ were as large as those of the alligator. These saurians have deeply biconcave and mostly notochordal vertebræ, with intercentra, and are referred to the order *Rhynchocephalia* by their describer.

Several genera and species allied to *Mastodonsaurus* were obtained. *Parioxys ferricolus* is a new form with equal external teeth like *Rhinosaurus*, but with long mandibular angles. Two other genera belong to the *Ganocephala* of Owen, but differ much from *Archegosaurus.* In *Trimerorhachis* the neurapophyses are united into a v-shaped bone with zygapophyses and no neural spine.

The centrum is represented by a cortical ossification of the chorda dorsalis on each side, while a large crescent-shaped ossification of the sheath alternates with the neural arches on the inferior side. This body is called the *intercentrum* by Prof. Cope. The basioccipital and parasphenoid bones are ossified, and the former bears a cup-shaped articulation for the first vertebra, and is fissured for the chorda. The only species is the *T. insignis.* The other genus is *Rhachitomus.* Here the centrum is replaced by the large intercentrum, and the neurapophyses bear part of the articular surface usually carried by the latter. They bear a continuous neural spine. The chorda dorsalis is much reduced by the ossification of the intercentra. The typical species was probably larger than the *Empedocles alatus*, and has been named *Rhachitomus valens.*

More than twenty species of this fauna have been determined by Prof. Cope, and mostly described in a paper read before the American Philosophical Society on March 5th.

GEOGRAPHY AND TRAVELS.

THE GEOGRAPHICAL WORK OF THE YEAR.—In his annual presidential address before the American Geographical Society, Feb. 27th, Judge Daly, reviewed the geographical work of the year. He first drew attention to the confirmation by the English Arctic Expedition of the discovery by Dr. E. Bessels of the junction of two important tides in the larger part of Smith's Sound, creating the impression that a new type of tide has been ascertained, occurring every eight hours. After detailing Dr. Schliemann's discoveries, and the different national surveys, he alluded at some length to the topographical survey of New York. In pursuance of the recommendation of the society, an act was passed and an appropriation of $20,000 was voted for beginning the work. The general secretary of the society, James T. Gardner, was appointed director, and the work has now been in progress two years under his charge. The triangulation has been carried through the eastern-central part of the State, extending from the Hudson river to Utica, over an area of about 3,000 square miles, including parts of eleven counties. The work is of the highest order of accuracy. Every city, village and hamlet is thus located with absolute precision. A map has just been published, accompanying the report of the director. A comparison of this with the former maps shows that on the old map of this part of the State, the cities and villages are often misplaced more than a mile. The survey has not found a single town where it was represented to be on the old maps. During the coming season, the triangulation would be extended across the entire State.

Lieutenant Wyse, of the French navy, who conducted the expedition for ascertaining a route for a canal across the Isthmus of Darien, completed his reconnoissance during the year and has

published his preliminary report. His conclusion is that no navigable channel is possible between the Tuyra and the Atrato without locks or tunneling.

Dr. A. Le Plongeon has been engaged for some time in researches in Yucatan among the ruins of Chichen Itza, Uxinal and Aké, and those of the once famous islands of Azumel and Mujeres, and has made many interesting discoveries. He has taken many valuable photographic views of ruins, structures and hieroglyphics, and discovered a remarkable statue which was buried twenty-one feet in the ground. He also discovered some other figures in the Island of Mujeres; he thinks that relations formerly existed between the people of Yucatan and the inhabitants of the islands on the west coast of Africa, as he finds many things resembling the Guanches, the early inhabitants of the Canary Islands, whose mummies are yet found in the caves of Teneriffe, and in other islands of the group.

In South America Major D. A. Rivara and M. A. Werthemen have been exploring in the mountains of Peru, M. Weiner in Bolivia, and Signor F. P. Moreno in Patagonia. They have been measuring the heights of mountains and seeking the sources of rivers. Many interesting facts have been learned.

There have been many explorers in Asia; in Palestine, Persia, Turkestan, Thibet, China, India and Japan. Herr E. Knipping has been engaged in extensive surveys in Japan, and has completed a large map of the country, which will soon be published. He was last surveying a route from Kobi to Tokio, a distance of over 3000 miles.

Mr. Wojeikoff completed his meteorological journey round the world, during the course of which it will be remembered we had the pleasure of seeing him at one of our meetings. His last visit was to India, Java and Japan, and he made an excursion into a part of the interior of Japan never before visited by Europeans.

When I referred to Mr. Stanley in my last address, he had finished his expedition to Lake Akengara, south-west of Lake Ukerewe, and was on his way to Lake Tanganika to explore the country south of the Mwutan Nizige, and north-west of that lake, in the hope of reaching the Mombutto country at the north, so as to connect his own discoveries with those of Schweinfurth, across the equator. It will be remembered that I mentioned last year that Lieut. Cameron circumnavigated Lake Tanganika, and concluded, from his own observations, that he had discovered the outlet of the lake in the River Lukuga, flowing from it on the western side. An ordinary traveler would have been satisfied with Cameron's survey and his conclusion as to the outlet, but Stanley, in the true character of a geographical explorer, determined to go round the southern part of the lake himself, and the result was that he ascertained by a detailed survey and careful soundings that the River Lukuga, instead of flowing out of the lake, flowed into it.

After completing this work, Stanley started with a force of 140 porters for Nyangwa, the farthest northern point attained by Livingston or Cameron, carrying his boat, the Lady Alice, with him in sections. Stanley reached this place in November, 1876, after a journey of about 350 miles in forty days; in itself, a remarkable geographical feat. Those only who are acquainted with the dangers and difficulties of African exploration, know how frequently the most sagacious conclusions, founded upon what seemed to be the most trustworthy information, have not only been attended by failure, but with the most disastrous results, can fully appreciate what Stanley undertook, and the hazard he ran in determining to follow the Lualaba river in its northerly course. The river ran to the north, apparently in the direction of the sources of the Nile. He had Livingstone's conviction that it was the remote source of that river. To follow the river, however, in its northerly course, might lead him, if his theory should not be verified, into the interior of Northern Africa, where he would be, with a large body of followers, without supplies, and in a state of utter destitution. He appreciated the great risk he ran, but after fully considering it, he came to the bold determination to follow up his theory, and in this exhibited the same geographical instinct which he has referred to as such a remarkable faculty in Captain Speke, the discoverer of Lake Ukerewe. He accordingly started to follow the river to the north. He reached the Atlantic coast in August, 1877, having made a journey from Uyangwa down the river to its mouth, a distance of about 1,800 miles, passing on the way fifty-seven cataracts.

When we saw Mr. Stanley here in the society, his hair was black; it is now said to be entirely white. Of the 350 men with whom he left Zanzibar, in 1874, only 115 reached the Atlantic coast, and 60 of these, when at the journey's end, were suffering from dysentery, scurvy and dropsy. He was on the Congo from November 1, 1876, to August 11, 1877,—a period of over nine months; so that his promise to the native followers was fulfilled, that he would reach the sea before the close of the year.

It remains only to refer to the geographical knowledge which has been obtained by this remarkable exploration. The entire area drained by this great African river, Stanley computes at 860,000 square miles, 450,000 of which are taken up by the great basin and the maritime regions of the west. The source of the Congo, as now ascertained, is in the high plateau south of Lake Tanganika, in a country commonly called Beza, or Ubeza, but from Moesa Lake to the river Lualaba no European knows anything of its affluents. The Congo issues from Lake Bembo, called by Livingstone, who discovered it, Bangwelo. Descending beyond 17° E. longitude, the Congo spreads out into an enormous breadth, and then slowly contracts between hills, when it thunders down, steep after steep, for 180 miles, and then flows as the ma-

jestic and calm Lower Congo. In this 180 miles it has a fall of 585 feet. Stanley found the people in this region very friendly. It is navigable for 110 miles from its mouth to the first rapids and beyond them for 835 miles, while the great affluents he estimates which flow into it from the north and south would give 1,200 miles and perhaps more. He estimates its greatest affluent, the Ikelemba, to be over 1,000 miles in length, the Nakuta or Kwango to be over 500 miles, while there are four or five others which, from their breadth, he thinks, should be navigable for great distances. The Nile, he says, has greater length than the Congo, but the Congo could furnish water for three Niles, and it is a much more valuable river for commerce than the Nile, as the Congo has its rapids concentrated in two places, and is not, like the Nile, frequently interrupted by rapids. The upper rapids, where all navigation westward on the Upper Congo terminates, has six great falls, while the lower series has sixty-two important falls and rapids, with many minor ones. Once above the lower cataracts, he says, we have the half of Africa before us, with no interruption like the desert regions of the Nile, but one vast populous plain, no part of Africa with which he is acquainted being so thickly inhabited. The term villages, he says, can scarcely be applied, for it is a collection of dwellings, and there are towns in some places two miles long, with one or more broad streets, and rows of neat and well-built houses, superior to anything to be found in Eastern Africa.

Fault has been found with Mr. Stanley, especially in England, for the warlike contests and destruction of savage life that attended his exploration, which it has been said will make it difficult for any future explorer to follow in the same direction, and which the objectors attribute to a too ready disposition on his part to employ fire arms instead of trying conciliatory measures. He was attacked in the beginning and continued to be attacked until he came to that part of the river where natives dwelt who had intercourse with the Atlantic coast, but as he has stated, and as there is every reason to believe, he acted throughout entirely on the defensive.

In no other way would it have been been possible for him to have followed the river as he did for 1,800 miles, and none but a man of his indomitable perseverance, courage, sagacity and tact could have carried through such an exploration, which is one of the most remarkable on record. When his exploration of the Congo is taken in connection with what he did in tracing the far-distant sources of the Nile, in the river that enters at the southern part of Lake Ukerewe (Victoria Nyanza); his successful circumnavigation of that great lake; the investigation of its tributaries, and what he ascertained in respect to Lake Tanganika, both on his first and his last examinations of it, it may be truthfully said that no man has ever, in explorations upon the land, done so

much for the acquisition of geographical information. In respect to the great water system of Africa, in its connection with the mystery of the Nile and the mystery of the Congo, he has solved an enigma that has attracted the attention of the world for ages, and fixed his name in the foremost rank of geographers, explorers and travelers.—*Condensed from the New York Tribune.*

MICROSCOPY.[1]

MICROSCOPICAL SECTION, TROY SCIENTIFIC ASSOCIATION.—A regular meeting of this section was held on the evening of April 1st, Dr. R. H. Ward, chairman of the section, in the chair.

Minutes of the last regular meeting and record of the subsequent soirée were read and approved.

Dr. Ward announced an invitation from the microscopists of Indianapolis to their fellow-workers throughout the country, to attend a *National Congress of Microscopists* in that city, commencing on Wednesday the 14th of August next, and adjourning in time for members to attend the meeting of the American Association at St. Louis, one week later. The biological section of the Indianapolis Lyceum of Natural History, assisted by many influential citizens, will make ample arrangements for the comfort and economy of visitors from abroad, both in obtaining reduced rates of travel and in the most liberal entertainment while in the city. A detailed statement of the proposed work of the congress and of the facilities offered by the local management will be given to the public, within a few weeks, in the form of a circular. The committee of arrangements, consisting of Prof. E. T. Cox, chairman, Mr. E. Sharpe, Dr. Henry Jameson and Dr W. W. Butterfield, secretary, have received the individual endorsement and promise of coöperation of leading microscopists, and now formally extend an invitation to the microscopical societies and workers throughout the country, with the assurance of a successful meeting. Such a congress, with its opportunities for stimulating microscopical work, discussing questions of general importance, and cultivating personal acquaintance among fellow-workers in the science, has been under consideration for some time, and the present year is believed to be an unusually favorable opportunity for the meeting, on account of the facility with which scientists from the eastern and southern sections can visit Indianapolis on their way to St. Louis, with no additional expense and no delay save the time spent at the congress. Microscopists desiring to attend should apply to the secretary of the committee for circulars giving further information, and should send notice of any important business to be offered for consideration, and titles of papers proposed to be read, accompanied by a copy of the papers or by abstracts of the same, to the secretary of the committee at

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

least two weeks before the time of the meeting, in order that a correct programme may be prepared.

The invitation to the congress at Indianapolis was, on motion, accepted, and it was resolved that members finding themselves able to attend should give early notice to that effect to the secretary of the committee, at No. 413 N. East street, Indianapolis.

Mr. Joseph McKay gave a demonstration of Prof. H. L. Smith's method of dry mounting by means of a background of wax and a curtain-ring cell, showing the facility and elegance with which this method may be carried out.

Rev. A. B. Hervey described a *New Method of Fluid Mounting* which he had recently devised. In his study of the algæ and lichens he had been troubled, as others have been, by the difficulty of permanently mounting specimens while studying them, without waste of time or change of arrangements. Most of the methods of mounting either ruin such objects entirely or else require considerable time, care, and special appliances that are troublesome to a busy student; and therefore instructive specimens are often neglected and lost. The objects may be transferred from water to Farrant's solution of gum and glycerine and mounted without delay, but the structure is not well preserved and air bubbles are likely to be obstinately present. The objects show best in distilled water, sea water, camphor water, etc.; and to mount them instantly and with uniform success he prepares cells of the gum and glycerine solution put on by means of the turn table in the usual way. Having made cells of the required depth, and laid them aside until thoroughly dry, the inner half of the width of the cell is varnished on the turn table with gold size, which is also allowed time to dry perfectly. Objects in water are arranged and covered in these cells with ease, and are ready after lying aside for a time varying from a few minutes to a few hours, to receive a coat of gold size or other varnish, the fluid that exudes from the cell in pressing down the cover glass having dissolved enough of the gum cell to hold the cover in position. It has not been found that the cell is too much affected by the fluid; but if it should be so the cell could be made of the usual cements, insoluble in water, and then coated with a thin layer of gum.

Mr. C. E. Hanaman demonstrated the use of the Nachét camera lucida, and quoted opinions from discussions at the Queckett Club to confirm its superior facility of use as compared with the other forms of camera.

Dr. Ward presented the *New Self-centering Turn-table* recently contrived by W. H. Bulloch, of Chicago, and remarked that this table seemed to combine all the really radical improvements that have been made in the turn-table up to the present time. The early tables were more or less satisfactory varieties of the original Shadbolt form, and were arranged to be whirled in a variety of

ways; but the first fundamental improvement was the self-centering table of Dr. Matthews, which centered the slide for width only between jaws swinging on opposite posts and held it in place by means of a sliding wedge. This method is greatly simplified without at all impairing its efficiency, by discarding the wedge and jaws and centering by the posts alone, in the table contrived and now made by Mr. Zentmayer. Mr. Cox has undisputed priority in the expedient which now surpasses all others, and seems likely to continue to do so, of centering for both width and length by grasping the diagonally opposite corners of the slide between jaws that move automatically towards or from the center, after the manner of the different forms of American scroll chucks. In Mr. Cox's table, now well known, the jaws are moved by a horizontal screw, with right and left threads on the opposite ends, under the revolving plate. Mr. Kinne adopted independently, but published subsequently, the same principle, but moved the jaws by a lever instead of a screw. Mr. Bulloch's table is essentially a modification of the Cox table, but moves the jaws by a scroll screw on the surface of a revolving plate, precisely as is done in the scroll chucks of the machinists. The revolving table is made double, of two horizontal plates, the jaws sliding through the upper plate by means of a screw on the upper surface of the lower plate, thus securing a very steady as well as convenient and durable adjustment. In addition to this, the posts and clips are added after Mr. Zentmayer's method, by which the slide may be centered for width only. or under which it may be adjusted artificially by means of concentric rings as in the early forms of tables. The workmanship is good beyond comparison with anything of the kind except the one last mentioned; and the instrument, at its moderate price, can be commended as a real luxury to any one who desires a more elaborate form than that. It is one of the little things that are a great comfort.

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SCIENTIFIC NEWS.

— Recent arrivals at the Philadelphia Zoölogical Garden: 1 great-horned owl (*Bubo virginianus*), presented; 1 zebu (*Bos indicus*) ♀, India, born in the Garden; 1 crested anolis (*Anolis equestris*), and 1 tree boa (*Epicrates angulifer*), West Indies, presented; 2 Cashmere goats (*Capra hircus var.*) ♀, born in the Garden; 2 woodchucks (*Arctomys monax*), presented; 1 raccoon (*Procyon lotor*), presented; 1 common seal (*Phoca vitulina*) ♀, purchased; 1 macaque monkey (*Macacus nemestrinus*) ♀ India, born in the Garden; 3 alligators (*Alligator mississippiensis*), presented; 1 herring gull (*Larus argentatus*); 4 sirens (*Siren lacertina*), Southeastern U. S., presented; 2 spotted salamanders (*Salamandra maculosa*), Europe and North Africa, presented; 1 bactrian camel (*Camelus bactrianus*) ♂, Asia, born in the Garden.—*Arthur E. Brown, Genl. Supt., April* 1, 1878.

— It is with great sorrow that we announce the sudden death of Prof. Charles Frederic Hartt, Chief of the Brazilian Geological Commission. He died at Rio de Janeiro, March 18. His untimely death is a great calamity, as, after nearly three years of constant exploration over a large part of Brazil, he had begun to prepare for publication the results of the researches of himself and assistants, Messrs. Derby and Rathbun. He was born at Fredericton, New Brunswick, in 1840, and graduated at Acadia College at Wolfville, Nova Scotia. He was a student under Agassiz from 1862 until 1865, and during that time investigated the Devonian plant and insect beds of St. John, and made important researches in the Cambrian fossils of the Acadian series at St. John. He then accompanied Agassiz as Geologist of his journey up the Amazon and subsequently made three visits to the coast regions, and the results of his explorations are comprised in his work on "The Geology and Physical Geography of Brazil," published in 1870. Several years previous he was appointed Professor of Geology and Physical Geography at Cornell University. He made a specialty of Brazilian geology, and mastered the Portuguese language, investigated the natural history and archæology of that country, and so identified himself with its physical history that it seemed as a matter of course that the Emperor of Brazil should honor himself by appointing the young explorer Chief of the Imperial Geological Commission. This was in May, 1875; since then his studies have extended widely over the Empire, including the unraveling of the geology of the Amazon, consisting of Silurian, Devonian and Carboniferous rocks, the thorough examination of the coast and interior of the Province of Pernambuco, a reconnaissance of the diamond and gold districts of Minas Geraes, the examination of large areas in San Paulo and Santa Catharina. The survey had collected enormous quantities of fossils and zoölogical material from the Corniferous and Carboniferous formations in the Amazonian valley, large numbers of remains of vertebrates and invertebrates from Pernambuco, including many new reptilian and amphibian forms, mainly cretaceous. For the last six months but little field work had been done and publication was progressing rapidly. Prof. Hartt also made a thorough study of the coral reefs of the coast of Pernambuco, including ancient and modern forms. He also amassed many facts regarding the language, manners and customs of the Tupis, Guaranis and other Indian tribes, and Brazilian archæology.

Professor Hartt, besides being a geologist, palæontologist and zoölogist, was a capital linguist and philologist. He had powers of rapid acquisition and great versatility. He was a person of warm sympathies, and of a cheerful, light-hearted spirit that endeared him to all with whom he came in contact. To the readers of this journal, to which he often contributed on geological and

archæological subjects, his powers of exposition are well known. His death is a serious blow to American science. All will deplore his loss; his memory will be cherished by his fellow-students and associates who knew him best and appreciated his moral worth and his intellectual and scientific attainments.

— Dr. Charles Pickering died in Boston March 18. He was born in Susquehanna Co., Pennsylvania, Nov. 10, 1805. He was a graduate of Harvard, in the class of 1823, and of the Medical College in 1826. He was a member of the American Academy of Arts and Sciences, and of the American Philosophical Society; was the Naturalist of the U. S. Exploring Expedition under Commodore Wilkes in 1838–1842; practiced medicine in Philadelphia for several years, and afterwards removed to Boston. Besides his report of the Exploring Expedition he was the author of several valuable scientific publications.

The exploring expedition returned, leaving certain countries that required to be visited to complete the survey of the globe. Accordingly, after remaining a little over a year at Washington, Dr. Pickering set out alone in 1843 for Malta, Egypt, down the Red sea to Zanzibar, and thence to Bombay, returning after an absence of twenty-two months. He then prepared and published his work on The Races of Man and their Geographical Distribution.

Robert Swinhoe, well known as a writer on East Indian ornithology, etc., died in London, October 28, 1877, at the age of 41 years.

Francois Vincent Raspail, the French botanist, well known for his studies on the grasses, and his Nouveau Système de Physiologie Végétale et de Botanique, died near Paris, January 6th, aged 87 years.

John J. Monteiro, the author of Angola and the River Congo, which we noticed in the last number of this journal, lately died at Delagoa bay.

— I inadvertently, in your January number, gave credence to the statement of Pouchet, the Curator of the Museum at Rouen, in regard to certain changes alleged to have taken place in the nests of the house martin (*Chelidon urbica*); I had repeatedly seen the statement and was unaware that its correctness had ever been challenged. I learn from my friend, Prof. Newton, that there is nothing in the alleged progress in nest-building on the part of the martin whatever. The nest that is so well built is that of the sea mow (*Hirundo rustica*), while that of the martin continues unimproved. This matter was set right some years ago in the Zoölogical Record, but seems to have escaped notice, as the wonderful story of M. Pouchet still goes on its rounds unchallenged.—*T. M. Brewer.*

— Thanks to the interest taken in the young and vigorous Academy of Science at Davenport, Iowa, by one or two of the citizens and members, a new building well adapted to the wants of the Society has just been finished, one or two meetings having been held in it. The second part of its Proceedings will appear at an early date.

— Capt. Howgate's bill for establishing a Polar Colony has met with a favorable hearing by the Congressional committee, and it seems most probable that Congress will appropriate $50,000 for the undertaking, which promises so much for the advancement of Polar research.

— The third session of the Summer School of Biology will be opened at the Museum of the Peabody Academy of Science, Salem, Mass., beginning July 5th, and continuing six weeks. A lecture will be given each Monday, Tuesday, Wednesday, Thursday and Friday at 9 A. M., the remainder of the time to be given to laboratory work and demonstrations, as it is designed to make the course a practical one, so that teachers may learn the *method of study and teaching in Natural History*. During the present session special attention will be given to Entomology, the study of Spiders and Crustacea, as well as the Anatomy of Vertebrates, and the study of Animal Tissues.

Instruction in Zoology will be given by Dr. A. S. Packard, Jr., with the assistance of Messrs. Charles Sedgwick Minot, James H. Emerton, and J. S Kingsley. Mr. Minot will lecture on Histology and on the Anatomy of Vertebrates. Mr. Emerton will lecture on Spiders, Scorpions and Mites, Mr. Kingsley on the Crustacea, and Dr. Packard will give a course of lectures on the lower animals and the Insects. Rev. Dr. Bolles will give a series of six afternoon lectures on Microscopy, at 3 P. M., beginning July 12.

For further information apply to A. S. Packard, Jr., Director, Peabody Academy of Science, Salem, Mass.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History. — March 6. Mr. S. H. Scudder made a communication on Prodryas, a new fossil butterfly from the tertiary beds of Colorado.

On March 20, Prof. A. H. Niles read some notes upon the erosive power of the glaciers and sub-glacial streams of the Alps, based on a summer's exploration. He took the view that a large part of the erosive action was carried on by the running water of the sub-glacial streams, rather than by the ice itself, which, however, accomplished the polishing and scratching. Dr. David Hunt spoke of a possible cause of prognathism.

April 3d.—Prof. B. G. Wilder exhibited living specimens of Amia, and spoke of its ærial respiration, and Mr. S. H. Scudder remarked on the early life of some tertiary insects, and particularly on the eggs of a fossil Corydalus (hellgramite).

SCIENTIFIC SERIALS.

AMERICAN JOURNAL OF SCIENCE AND ARTS.—March. New genera of Pycnogonidæ, by F. B. Wilson. New dinosaurian reptiles, by O. C. Marsh.—April. Surface geology of south-west Pennsylvania, by J. J. Stevenson. The driftless interior of North America, by J. D. Dana. The ancient outlet of Great Salt Lake, by G. K. Gilbert. Intrusive nature of the Triassic trap-sheets of New Jersey, by I. C. Russell. Tree-like fossil plant, Glyptodendron, in the upper Silurian rocks of Ohio, by E. W. Claypole.

BULLETIN OF THE AMERICAN GEOGRAPHICAL SOCIETY, No. 5.—Modern researches in Palestine, by Rev. S. Merrill. My first trip up the Magdalena, and life in the heart of the Andes, by J. A. Bennet.

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ARCHIV. FÜR NATURGESCHICHTE.—Heft. 2. A. W. Malin, on the migration of birds. Gurlt and Schilling give a list of animals on which parasitic insects live. Helminthological papers, by J. Ulieny and Linstow. Ichthyological notices, by Linstow. Herpetological studies, by J. v. Bedriaga.

ARBEITEN AUS DEM ZOÖLOGISCH-ZOÖTOMISCH INSTITUT IN WÜRZBURG.—Bd. iv, Heft. 1. May 20. *Lacerta lilfordi* and *L. musalis*. biological and anatomical studies, by M. Braun. Contribution to the biology of Oligochæta, by C. Semper (relates to the laws of budding and self-division in Nais, etc). Bd. iv, Heft. 2 (no date). The urogenital system of native reptiles, by M. Braun. Heft. 3, Jan. 1878. On the signification of the cuticular bristle on the adhesive pads on the soles of the Gekotidæ, by M. Braun. The genus *Cryptoniscdæ* (Liriope) by P. Fraisse.

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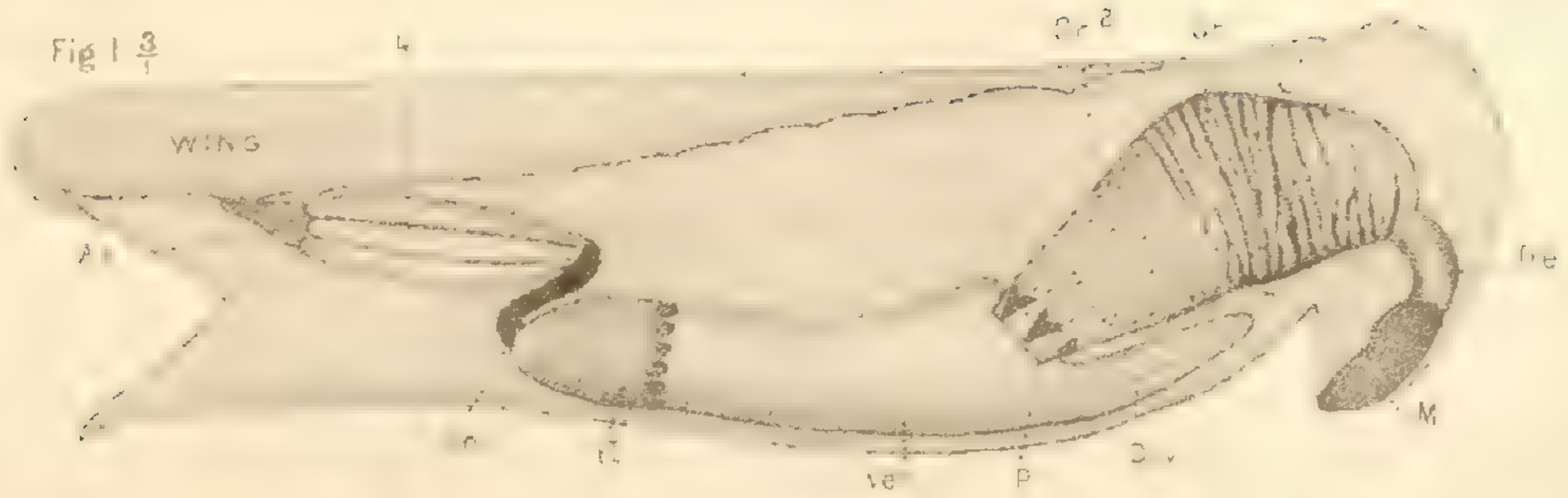

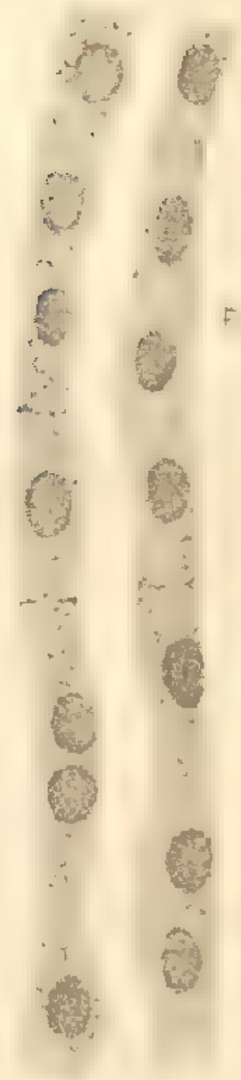

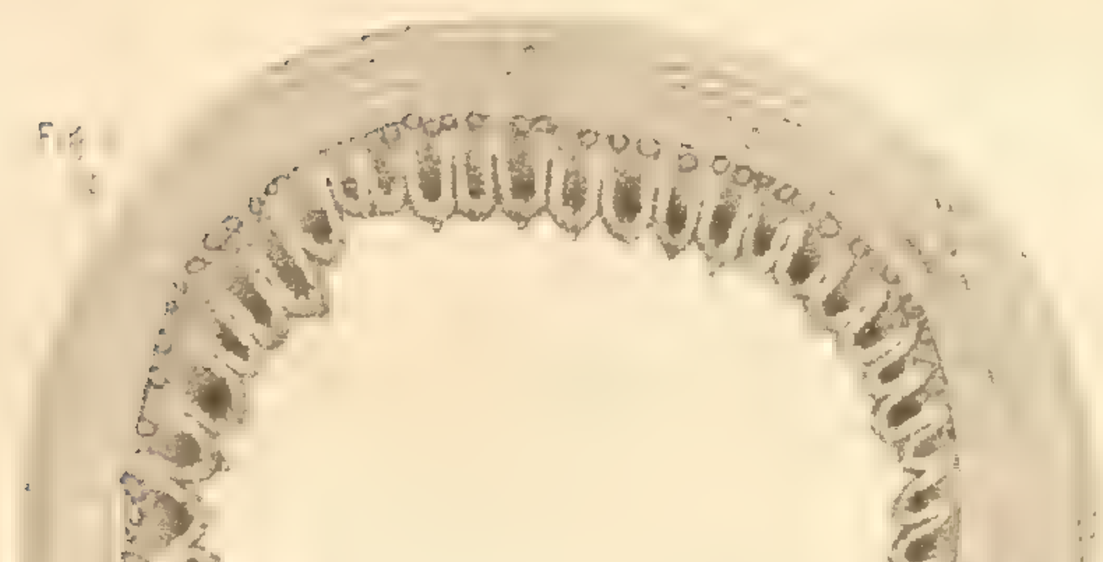

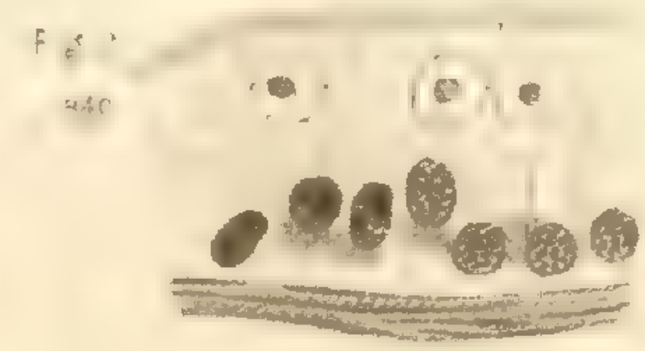

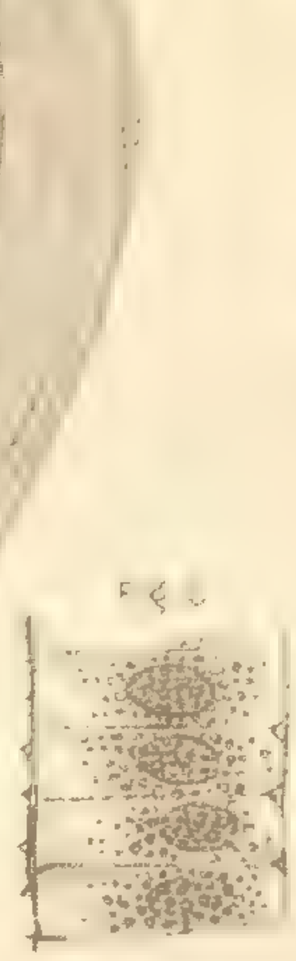

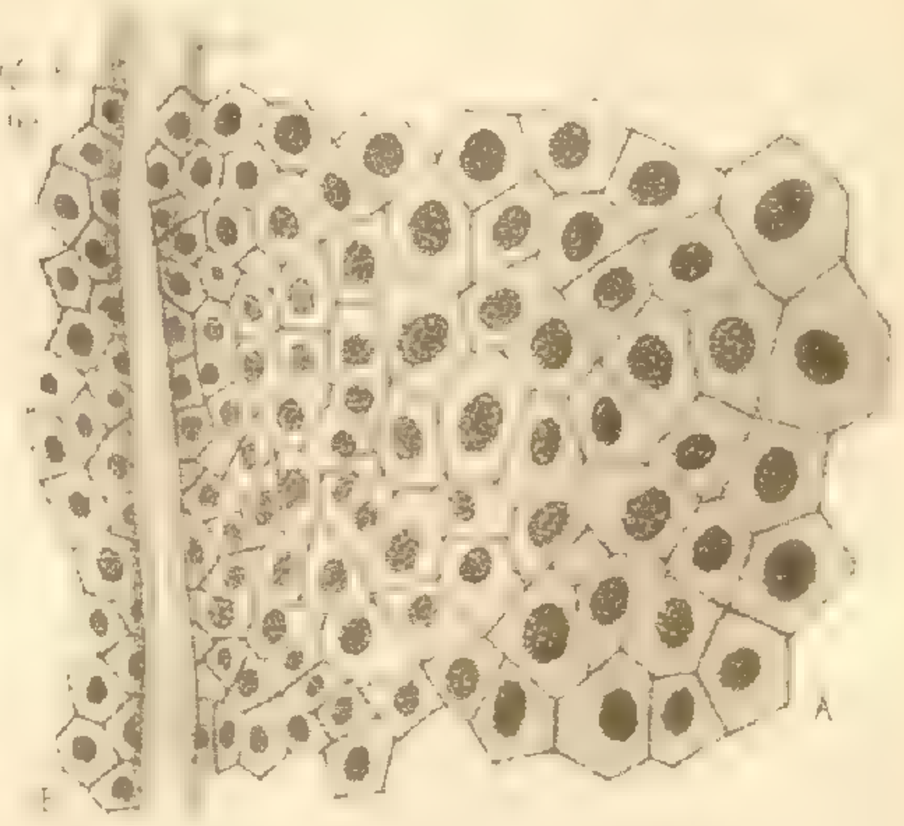

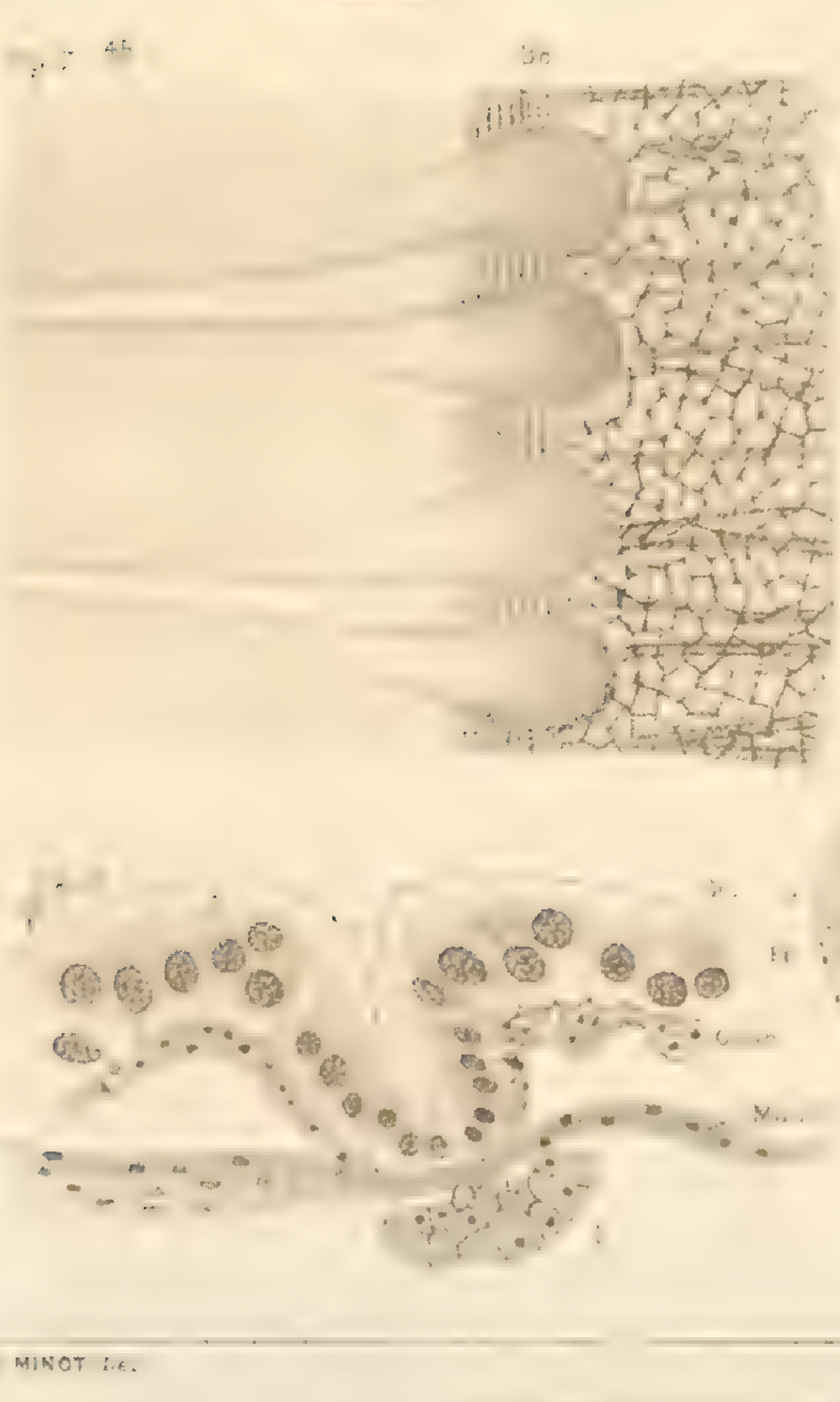

C. S. MINOT del. Sinclair & Son lith.

HISTOLOGY OF THE LOCUST.

EXPLANATION OF THE PLATE.

FIG. 1.—Longitudinal median section of *Caloptenus femur-rubrum*, female, to show the course and divisions of the digestive canal. *M*, mouth; *Oe*, œsophagus; Cr^1 anterior, Cr^2 posterior part of crop; *P*, proventriculus; *Div*, blind sack or diverticulum of the stomach; *Ven*, ventricle; *Il*, ileum; *col*, colon; *R*, rectum; *An*, anus.

FIG. 2.—Optical section of Malpighian tube.

FIG. 3.—Section of the epithelium of the rectum of *Caloptenus spretus*.

FIG. 4.—Transverse section of the hind part of the crop; *s s*, spines of the cuticula; *rid*, ridges; *L*, longitudinal; *muc. C*, circular muscular coat.

FIG. 5.—Epithelium of the ileal folds; *A*, middle of folds; *B*, furrow between folds; *L*, longitudinal muscular band.

FIG. 6.—Epithelial cells of the gastro-ileal valve of *Œdipoda sordida*.

FIG. 7.—Surface view of the gastro-ileal valves; *Ven*, ventricle; *Bd*, circular muscular band underneath the folds; *Il*, ileum.

FIG. 8.—Transverse section of a diverticulum. *Tr*, trachea; *muc*, circular muscular coat.

FIG. 9.—Transverse section through the furrow; *F*, between two ileal folds; *cu*, cuticula; *Ep*, epithelium; *conn*, connective tissue; *muc. C*, circular muscles; *L*, longitudinal muscular band.

FIG. 10.—Transverse section of the gastro-ileal folds of *Œdipoda sordida*: *muc*, muscular band, *Bd*, of Fig. 7.

THE

AMERICAN NATURALIST.

VOL. XII. — *JUNE*, 1878. — No. 6.

A LESSON IN COMPARATIVE HISTOLOGY.

WITH PLATE II.

BY CHARLES SEDGWICK MINOT.

ONE of the first scraps of information which a young naturalist is apt to acquire, when he learns something of the history of zoölogy, is the knowledge of the great names of Linné and Cuvier. The reforms effected by these two great men in the methods of studying animated nature would alone secure them enduring fame; when we reflect, however, that they also labored industriously to add to our knowledge, and were successful as investigators as well as reformers, we must yield to the conviction that the honorable prominence assigned to them among naturalists is their just due. After both Linnæus and Cuvier had been dead for years, a German *savant* made a discovery concerning the elementary structure of plants, which revealed the fact that all the parts of plants are built up out of the same units, which have ever since been called cells. This great generalization is now taught to every botany class as one of the fundamental principles of vegetable anatomy and physiology, and the name of its great discoverer, Schleiden, is generally coupled with it. Schleiden made the results of his investigations generally known in the year 1837; and it was only two years later that his friend and countryman, Schwann, published a memoir showing that the same units—the cells—are found in all animals as well.

It is a familiar fact to all, in these days when natural science has penetrated to the schoolhouse and the magazines, that matter consists of molecules, or minute particles, which are themselves composed of other particles still more minute—the atoms. Every mass of matter is made up of molecules, and indefinite numbers of molecules may be added to a mass without essentially

changing anything but its size. In living matter, however, nature presents an exception to the universality of this law; for in living bodies the molecules, which are far smaller than the smallest visible particles, are united to form masses of limited size, which represent so many units of the body, just as we might say the bricks represent so many units of a wall. These units of life, as I may call them at the risk of being misunderstood, are the cells before mentioned. The great material difference, therefore, between living and unorganized bodies was at once demonstrated by the discoveries of Schleiden and Schwann, and it is on this account that naturalists attribute such importance to the work of these two men. In truth Schwann's investigations caused as great a change in the direction pursued by zoölogists in their researches as the reform either of Linnæus or Cuvier. But Schwann unlike his great predecessors did not continually make further discoveries, and has not, as far as I am aware, participated in the work of original research, which has been in progress during his life time, so that to most of us perhaps he already seems a person of the distant past.

Yet during Schwann's lifetime one of the principal labors of zoölogists has been the working out in detail the applications of his generalization, and determining the variations and modifications which cells undergo in the different tissues and species of animals, until finally the subject has assumed an importance even more vast than could at first have been foreseen. It is in fact hardly an exaggeration to say that all our knowledge of animals groups itself about the doctrine of cells, as the central factor upon which all others depend; and whether we labor as physiologists, embryologists or anatomists, we are alike forced ultimately to base all our conclusions, and demonstrate all our theorems by the character and property of cells. In brief, what a knowledge of waves is to the student of sound, a knowledge of cells is to the student of life.

It would be a pleasant task to expatiate at length upon the various bearings of the cell doctrine, for we should deal with many of the fundamental problems of zoölogy, and with some of the most interesting additions to our knowledge in this department of science which have ever been made. This course would take us away from the real subject of this article, the object of which is to give an example of how much may be learned by

the study of the cellular anatomy of even the commonest animals, therefore I must resign for the present the wider and more attractive field, and descend to details, in order to show by a concrete example some of the modifications which cells present, and to describe the appearance of some of them when prepared for microscopical examination.

My illustrations are all taken from the common locust, and are selected from the results of a recent original investigation on the histological structure of that abundant pest. The work was undertaken at the desire of Dr. A. S. Packard, Jr., in connection with the more directly practical labors of the U. S. Entomological Commission, and it is to the kindness of Dr. Packard that I owe the opportunity of utilizing my observations for this article.

I will merely remind the reader that the anatomy of the locust may be most readily understood by saying that its body is formed by an outer wall, including the external crust and the underlying muscles, and an internal tube, the digestive canal, the diameter and course of which are very irregular, as is shown in Fig. 1 of the accompanying plate. Between the body walls and the alimentary canal there is a large cavity in which various internal organs, notably those of circulation, respiration, and reproduction are situated.

Now, all these parts are composed of minute cells, and the examination of almost any one of them will suffice to show cells that are very characteristic. Let us take for instance a male grasshopper. The sexes may be readily distinguished by the position of the claspers at the end of the abdomen, which is straight in the female, while in the male it is curled upwards, so that the end of the abdomen appears club-shaped and the claspers seem placed on the back.

Opening the insect along its back, and spreading out the sides so as to expose the internal organs, almost the first things that strike the eye are the numberless glistening silvery threads, the ramifications of the tracheal tubes. These must be torn asunder in order to lay bare the reproductive organs, which form a large mass overlying the stomach in the anterior part of the abdomen; trace these organs downwards, following them around the sides of the intestine to the ventral and posterior part of the abdomen, and there will be found numerous long *white* tubes; these are the

vesiculæ seminales, which open into the long ducts of the spermaries and end blindly. If one of these be isolated, and then colored with hæmatoxiline or carmine, and examined in a drop of glycerine with the microscope, its walls will exhibit a great many minute colored dots of oval shape; these are the so-called *nuclei* of the cells; it is evident that they form but a single layer, for in no part of the wall of the tube do they lie over one another. By looking carefully it is possible to distinguish a faint polygonal outline around each nucleus; these outlines correspond to the surfaces by which the cells abut against one another. Thus we learn at once that a cell is a very minute body with granular contents, and a distinctly differentiated central portion, the *nucleus*, and moreover that the cells are laid close against one another, and cemented together by thin intervening layers known as the *intercellular substance*. But every *vesicula* consists of a wider upper portion, which is usually found filled with spermatozoa in the mature animal, and the walls of which are composed almost entirely of the layer of cells just described; and a narrower portion enclosed in a sheath of muscular fibres. This difference can be most plainly recognized by preparing transverse sections, which may be made with a razor from tubes that have been hardened in alcohol. The operation has already been described in the NATURALIST for July, 1877, and to that the reader is referred. A section through the upper part is represented in Fig. 1. The single cells, each with its darkly stained and coarsely granular nucleus, lies close against its fellows. They are all of about the same height, and form a single continuous layer. Every layer of this kind that lines any cavity whatsover is called an *epithelium*. A section through the lower segment of the *vesicula* presents quite another appearance, as is shown in Fig. 2. The epithelium, *Ep*, still lines the cavity, but the cells are very much smaller than in the upper part, though they form but a continuation of the same layer. From this we learn that cells vary greatly in size, but the limits are much further apart than is here indicated. Outside the epithelium is a very thick and powerful coat of muscular fibres, *Mu*, which

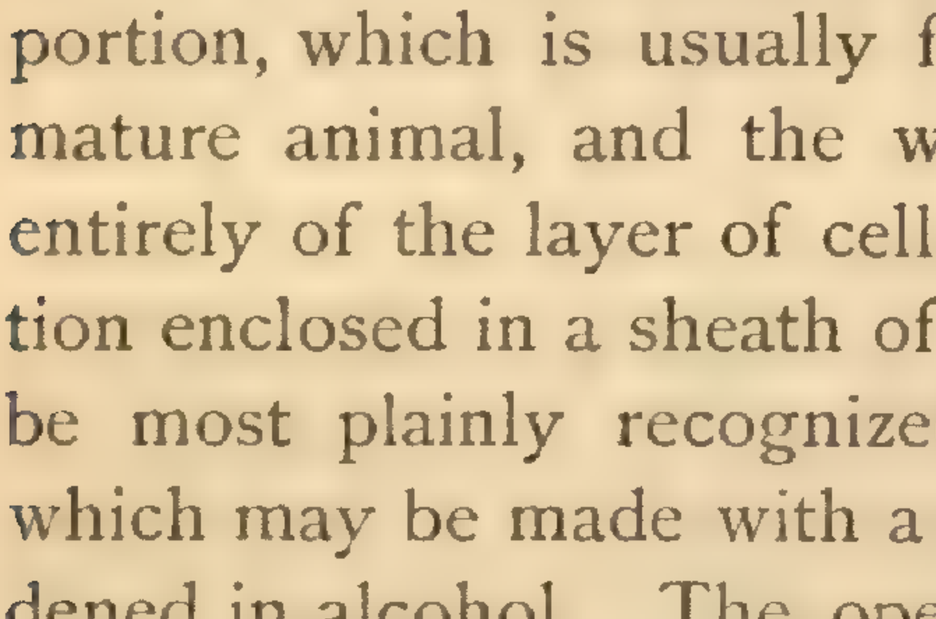

FIG. 1.—Section of upper part of Vesicula seminalis.

encircle the canal. Among the fibres occur elongated nuclei. Each muscular fibre in fact is a greatly elongated and peculiarly modified cell. But into this matter I cannot enter here; but I wish to point out that the lining membrane of the canals and ducts of animal bodies is generally if not always an epithelium, and that we frequently find the epithelium surrounded by a muscular coat. Thus may fundamental facts be observed on a single organ.

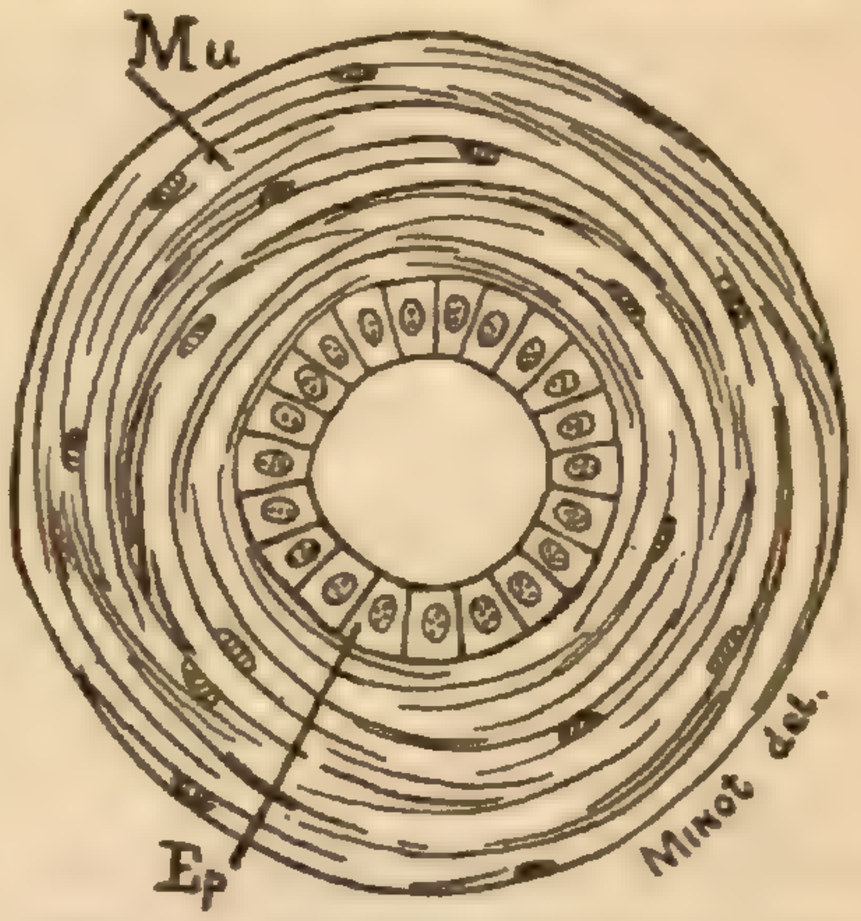

FIG. 2.—Section of lower part of Vesicula seminalis.

In the body of the locust there are long tubes, often pigmented, and opening into the digestive canal in the hind end of the stomach—they are the Malpighian vessels, so named after their illustrious discoverer. They make very beautiful preparations, if merely picked out, colored with carmine and mounted in glycerine, and are interesting to us because they have an epithelium which is very different from that above described. An optical section of part of one of them is represented on Plate II, Fig. 2. There is a very delicate external membrane which is hardly noticeable, though it forms a continuous external coating. Inside the epithelium is very distinct, but the cells which compose it instead of being high in proportion to their breadth are compressed; the nucleus is rounder, and the cell itself different from those of the seminal vesicle. The mass of matter which surrounds the nucleus is termed the protoplasm. Now, in the epithelium under examination the protoplasm of the cells is charged with coarse spherical granules. We naturally regard these peculiarities as somehow connected with the special function of these tubes, but in the majority of cases we are still unable to trace the relations of histological appearance to the physiological functions of organs. We have now made the acquaintance of a second kind of epithelium, and have learned to recognize cells by the presence of the nuclei, which, as far as we know, always have the property of being more darkly stained by various dyes than any other part of the cell. Moreover, each nucleus corresponds to a single cell, and there are never two nuclei in one cell. There are, however, some exceptions; thus the nervous cells (ganglia) of the sympathetic ganglia of vertebrates and of the

ureters of mammals (Englemann) frequently have two nuclei, and Dr. E. L. Mark, in his very valuable memoir on the *Coccidæ*, states that in the malpighian vessels of those insects he has likewise found cells with two nuclei.

The height of epithelial cells may be still further diminished, so that in some cases it may be said to have nearly disappeared, the cells assuming the form of a thin lamella. This is the case upon the air tubes. If one of these be colored and mounted in the usual way, the flattened epithelial cells may be easily recognized by their oval nuclei, Fig. 3 *b*. Each nucleus contains one or sometimes two minute spherical dots, eccentrically placed; these are the *nucleoli*. We have now seen the three constituent parts, which probably always enter into the composition of every cell; these are the protoplasm, the nucleus and the nucleolus. In addition we often find that the outside layer of the protoplasm becomes hardened and more resistent, and it is then called the membrane.

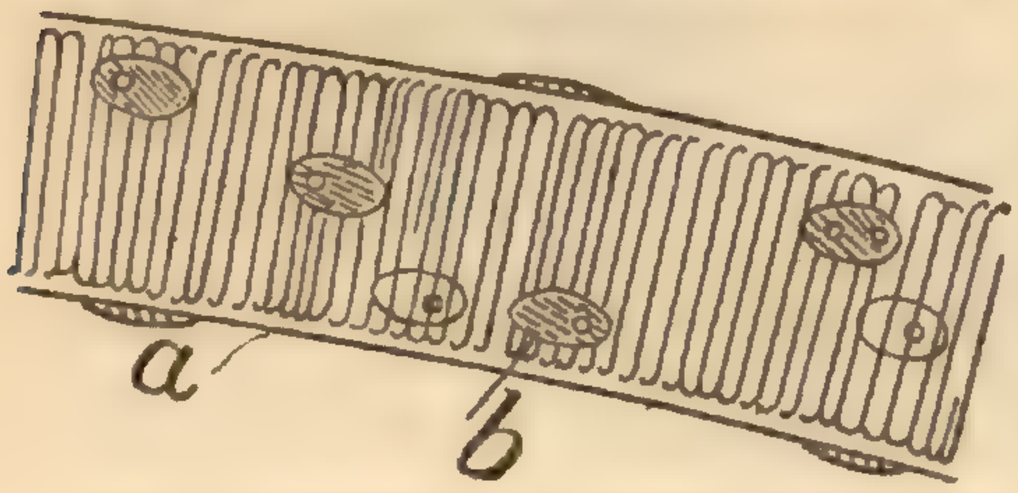

FIG. 3.—Small air tube from the abdomen.

In every epithelium we distinguish two kinds of surfaces on each cell, those which lie against other cells, and those which are free, facing the cavity. On the free surfaces the membrane is often considerably thickened, and the thickened portions are then so joined together that they form a continuous lamella, which is called a *cuticula*. Now the flat epithelium of the air tubes forms a very curious cuticula, which lines all the tracheæ, and is remarkable for being thickened in some places more than in others, thus developing a spiral thread, which can be seen in Fig. 3, underneath the nuclei. The spiral filament was observed very long ago, but its real nature was only recently discovered. For a more detailed account the reader is referred to the NATURALIST for July, 1877.

It is hoped that these illustrations will suffice to exemplify the more important features of epitheliums, tissues which are found in all animals except the protozoa, and represent one of the simplest and most frequent modes in which cells are aggregated. I propose to add a brief account of the structure of the digestive canal, in order to show some of the further modifications which epitheliums may undergo.

Fig. 1 of the plate represents a longitudinal section through a whole grasshopper, magnified three times. The cavity of the mouth, *M*, is not very large. The first segment of the digestive canal extends through the head and thorax, and is composed of two divisions, the narrow œsophagus, *Oe*, and the enormous crop, which is itself formed of two parts, an anterior, Cr^1, with transverse, and a posterior, Cr^2, with longitudinal ridges; this last terminates in a narrow portion, *P*, which corresponds to the proventriculus of other insects. This segment of the alimentary canal is especially characterized by its thick and hard cuticula, which almost completely obscures the underlying epithelium, outside of which, however, there is a powerful coat of muscular fibres of the kind called striated. The cuticula is thrown up into ridges and armed with fine but sharp spines that point backwards. The obvious function of these parts is to grind up the food: they are organs of mastication. The features in question are well shown in Fig. 4 of the plate, which represents a transverse section through the posterior part of the crop, magnified forty-five diameters. The ridges, *rid*, are small and numerous, and upon them can be seen the little spines, *s s*, and they are covered by the *cuticula*, which is very thick. The epithelium does not appear distinctly by this magnification, nor do the longitudinal muscles, *L*, but the transverse or circular muscles form a very thick layer, *muc. C.* Where the ridges are transverse, as in the front part of the crop and the œsophagus, we find the transverse muscles less developed and the longitudinal the most powerful.

The middle segment of the alimentary canal consists of the large ventricle, *ven*, known in German as the "*Chylusmagen*," with six blind sacks or diverticula appended to its anterior extremity; only one of these, however (*Div*), appears in the section Fig. 1. In this segment the cuticula is very delicate, but the epithelium undergoes another kind of modification, being thrown up into folds. In the diverticula there are twelve longitudinal folds, the structure and arrangement of which can best be seen in a transverse section colored with hæmatoxiline, Fig. 8, Plate II. The folds are high and thin, and covered by the epithelium, which is everywhere of about the same height. Outside there is a thin layer, *muc*, of muscular fibres, which do not enter into the composition of the folds. Between the muscles and the epithelium

there intervenes another kind of tissue, called *connective*, which also extends into the centre of each fold, separating the epithelium of the two sides. These three layers, the epithelium or *tunica mucosa*, the connective tissue or *tunica submucosa*, and the muscles or *tunica muscularis*, are the primary constituents of the digestive canal throughout the animal kingdom. It is always the epithelium which is the active agent of the secretion of the digestive juices as well as of the absorption of the food; hence it is important to make the surface of the epithelium which is to come in contact with the food as large as possible, and it is by the formation of folds of various shapes that this is accomplished.

The third and last segment of the alimentary tract consists of three divisions: first, the ileum, Plate , Fig. 1, which is as large in diameter as the stomach, for a part of which it was formerly mistaken; second, the very small colon, which bends forward and upwards (*col*), and opens dorsally into the larger and horizontal rectum, *R*. The whole of this segment is traversed by six longitudinal folds of the epithelium, which are broad with flat surfaces in both the ileum and rectum, but narrow and irregular in the intervening colon. Each of the six folds ends at the front end of the ileum in two rounded protuberances, making twelve in all. They have hitherto escaped notice. I propose for them the name of gastro-ileal valves. When viewed from their inner surface they have the appearance indicated by Fig. 7, being rounded in front and gradually fading out posteriorly. They are strongly pigmented. In transverse section, Fig. 10, we recognize the three characteristic layers, the epithelium which alone contains the pigment, the very distinct coat of connective tissue, and externally the muscular fibres. Examined with a higher power, Fig. 6, the epithelial cells will be found filled with round granules of various sizes of brownish color; which are the pigment; moreover, there is a thin but quite resistent cuticula armed with minute spines.

In the ileum we find the cells modified in still another way, as shown in Fig. 5, which is a surface view of part of the edge of one of the folds. The cells in the middle are quite large, but their size diminishes towards the edge, until at the edge itself they are comparatively diminutive. Fig. 9 is a transverse section through one of the furrows between two folds. *F* is the furrow; *Ep* the epithelium, the cells of which are smallest in the furrow. The epithelium rests upon a layer of connective tissue, *conn*,

which is separated from the muscular layer by a wide interspace, the muscular coat *muc. C* being attached to the connective only underneath the furrows, where there is also a single bend of longitudinal muscles, *L*, placed outside the transverse muscles.

Finally in the rectum, as shown in a transverse section, the epithelial cells are differentiated into two kinds, larger ones of the ordinary form, and smaller ones which lie higher up and present a circular outline. In vertebrates this differentiation of adjacent epithelial cells is carried to a great extent, and is especially connected with the development of glands; but the discussion of these is foreign to our present purpose.

In conclusion I will give a summary of our observations: Animals are built up of cells; each cell consists of a protoplasmatic body, a nucleus and a nucleolus; the cells are often grouped together so as to form a single continuous layer, which is called an epithelium; the free surface of such a layer is often covered by a thickened membrane, the cuticula, which is formed by the underlying cells. The cells of an epithelium may be modified, first as to size, second as to form, third, character of the cuticula, fourth, position, size, and shape of the nucleus and nucleolus, fifth, presence of granules or pigment, and sixth, differentiation of adjacent cells into two or more kinds. The epithelium may be modified by the formation of folds and pits of various forms.

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RAMBLES ROUND SAN FRANCISCO.

BY W. N. LOCKINGTON.

NO. I. THE OCEAN BEACH.

THE peninsula of San Francisco does not offer a very inviting field to the naturalist. A wilderness of rocky hills and sand-dunes, bearing no vegetation larger than a scrub oak, and swept by the winds and fogs of the great ocean, it lies, between the Pacific and the Bay of San Francisco, a bare and naked spot in the long wooded coast-line of California.

Yet, here as elsewhere, he who seeks with willing and educated eyes, will not fail to find much to interest him. The sand-dunes, the cliffs that border ocean and bay, and the rounded sandstone hills have each their special flora; many species of gulls, ducks and divers, herons, pelicans and cormorants visit the bay and the

marshes in the winter months; and the shores of the ocean and the bay, though poor in species compared with points either northward or southward along the coast, have each their characteristic forms of life.

Pleasant it is, when the clouds have rolled away, and the green hills and bay and ocean lie spread out before us in the glorious sunshine of a Californian spring morning, to leave the city's wooden sidewalks and ramble away to the ocean shore. On such a trip let us now start; let us feast, Barmecide fashion, on the good things of nature, bringing together, as those who feast in such fashion may, all the delicacies of the season to adorn our table.

In the centre of the peninsula, at some distance from any other hill, rises a conical elevation covered with loose sand and surmounted by a tall cross. Around it lie the cemeteries of the city, once far out of town but now becoming gradually surrounded by houses. Near the foot of this "Lone Mountain" we alight from the horse-car and strike out over the sand-hills toward the ocean, stopping, however, to pluck the flowers and to rummage among the old roots of the blue lupine (*Lupinus albifrons*) and the low bushes of groundsel-tree (*Baccharis consanguinea*) for the living treasures hidden there in the form of lizards and frogs which have not yet left their winter retreat. A pretty long-tailed black and white lizard (*Gerrhonotus multicarinatus* Blainv.) is our first prize, soon followed by a small tree frog (*Hyla regilla*). Another search brings to light a pair of "swifts," not birds but iguanine lizards (*Sceleporus undulatus* Harl.) and two or three more tree-frogs.

Our lizards are cold and sleepy, for the warmth of the sun has not yet penetrated to their place of concealment, but after a few minutes in our hands, exposed to the sun's rays, they became more lively, and ran off a short distance. The long slender Gerrhonotus, with his tail trailing along the ground, is strikingly different from the bluff-bodied conical-tailed Scelepori, with their rough-scaled gray backs lined with undulating short stripes of black, and displaying the bright blue of the sides of the abdomen.

Don't touch the Gerrhonotus incautiously when he gets lively, for if you catch him anywhere except just around the neck, he will surely either bite your finger sufficiently hard to make you

drop him, or he will drop off his own tail and leave you a spoiled specimen. The Scelepori are not so fond of throwing off their tails, nor nearly so apt to bite, but in summer time when they are active they are exceedingly hard to catch. They are not called swifts without reason.

What is the color of a tree-frog? Green for the most part, certainly, yet it varies greatly. The black marks upon the back are very distinct in some, quite faint in others, and one of our specimens is brownish, while another inclines to yellow. These fellows we have caught under the bushes are, in one sense, not so "green" as those we will find among the leaves at a more advanced season.

But our low bush furnishes us with insect as well as with reptile life. It literally swarms with "squash-bugs," big black millipedes (*Julus*) lie coiled among the decaying leaves, a long bright-red Scolopendra hurries away from our invading hand, and hunting spiders run to and fro in hot haste.

We are now on a rising ground at the edge of the Presidio reservation. Below us, in a little valley encircled by hills, lies a small fresh-water lake known as Mountain Lake, a line of shrubs beyond this marks the course of the stream which runs thence to the ocean, and the view is closed by the cliff-encircled bay outside the Golden Gate, forming the entrance to the harbor of San Francisco. Away on the farther side of the bay is the white lighthouse of Point Bonita, and oceanward a line of breakers marks the dreaded bar.

We hasten down to the lake, hoping to find there, as we have found before, numerous specimens of the fresh-water snails of the genera *Limnophysa*, *Physa* and *Helisoma*, as well as the tiny flat *Gyraulus vermicularis* Gld. But we have forgotten the thirty inches of rain that have fallen since we visited the spot in September last. The lake that was then so low that we could explore much of its bed, and so clear that we could see the bottom, is now a broad sheet of turbid water, in which the shell-fish are lost to sight. The spot where we picked up the flat-whorled Helisoma in shallow water, full of confervæ is now far from the shore, and the beach, once strewed with the shells of the fresh-water clam (*Anodonta wallamatensis*, sweet name this), is now lake bottom again.

The yellow water-lilies (*Nuphar advena*) whose tops and mas-

sive thick roots, marked, like the Sigillaria of the coal measures, with the scars of former leaves, which were in September either left high and dry, or in very shallow water, and from the under side of whose leaves we picked water-snails, together with a small crustacean (*Hyalella dentata* Smith), are now entirely covered by the water, and we can no longer grope our way among the long blades of the tule (*Scirpus lacustris*) sufficiently far to frighten out the grebes (*Podiceps californicus*) that make their home there. In revenge, we will gather flowers on our way to the ocean, and take notes on the vegetation of February. The blue nemophila (*N. insignis*), a garden favorite in England, abounds among the grass, the yellow sanicle (*Sanicula arctopoides*) is coming into flower, the blue lupine is budding, we pass a bush of the flowering currant (*Ribes sanguineum*) gay with its fragrant pink racemes, and the Californian poppy (*Eschscholtzia californica*) flaunts its yellow blossoms in the shelter of the bushes of *Rhamnus croceus*, whose blackberries are still abundant. The soft blackberries of the Rhamnus have each two large seeds, flat on one side, convex on the other, and not unlike a coffee-berry in shape; this resemblance has deceived many good people who know the roasted coffee-berry better than they do the coffee-plant, and has been the cause of oft-repeated stories in the Californian papers about the "Discovery of the coffee-plant in California."

The poisonous liliaceous plant, *Anticlea fremonti*, is thickly spread over the hillsides in many places, but its spikes of pale-yellow flowers do not attain half the height of their kindred on the eastern side of the bay. The common storks-bill, "alfileria" (*Erodium cicutarium*), is everywhere, and, in wet places, another introduced plant, *Cotula coronopifolia*, crowds out the natives. But we are now approaching the ocean, and it is low tide, so we must hurry on if we wish to gather from the rocks the chitons, limpets, barnacles and other marine forms. Among the sand-dunes, near high tide level, is a small pool of perfectly fresh water, overgrown with duckweed and the pretty *Azolla caroliniana*, which dots the pool with spots of brownish-red. Here we gather *Hyalella dentata* in abundance, and we know there are some fresh-water snails here also, but cannot stop to gather them. The shore, where we reach it, is sandy, but close by, to the left, commences the sinuous line of cliffs, enclosing several small coves, which terminates to the south-west of us at Point Lobos.

Below this line of cliffs lie detached masses of rocks of various sizes, and some of the smallest of these, near to us, are exposed at low tide sufficiently for our inspection.

Upon the farthest away and largest of these detached rocks (out of our sight now, hidden by the southern cape of the bay), is the home of the sea-lions; sea-wolves or *Lobos marinos* of the Spaniards. On our right the sandy shore continues for about three quarters of a mile, when the rocks again approach the sea, fringing it as far as Fort Point, where stands the brick fort built to defend the Golden Gate, but superseded now by extensive earth-works on the hills above. We can see also the fortifications of Lime Point, on the Marin county shore of the entrance to the harbor.

The rocks nearest the water are literally covered with stalked barnacles (*Pollicipes*) in bunches the size of the fist, and among them, conspicuous at a distance from their bright coloration, are groups of the common five-rayed starfish of the coast (*Asterias equalis* Stm). This stoutly-built starfish is remarkable from the fact that about half the individuals are of a bright purple tint, while the other half are an equally bright gamboge yellow. Out of several hundreds that I have seen, none were intermediate between these two types of color, and none, so far as I remember, showed spots or blotches of the two colors. Inside the harbor of San Francisco this starfish is abundant, and another species, *Asterias gigantea*, which attains a diameter of two feet, is also occasionally found, but I am not aware that the common pentagonal starfish of the coast, *Asteropsis imbricata*, has ever been taken within the heads, and the large twenty-armed *Pycnopodia helianthoides* does not occur so far south. On the rocks near Fort Point, adhering to the surface and of the same green tint with the seaweed around it, I have found a small Asteroid which I believe has not yet been scientifically described. It usually has six arms but some specimens have fewer, its surface is more even than that of *A. ochracea*, and in size it is a very dwarf, measuring about an inch across the arms.

But we must return to our examination of the rocks or the tide will soon bar our access to them. We secure several specimens of two species of chiton, *Mopalia hindsii* and *Katherina tunicata*, but it takes close looking to find them, as they lie close in crannies and among mussels and barnacles, and, moreover, are not

unlike the rock in color. In the last-named species the valves of the shell are almost entirely hidden by the thick mantle; nothing is visible but a row of little black bucklers along the median line of the animal.

The sculpturing of the surface of *Mopalia lindsii* is, like that of many of its relations, very delicate. Its nearest congener, *Mopalia muscosa*, and its gigantic relative, *Cryptochiton stelleri*, which when alive measures nearly a foot in length and is fully four inches wide, are not to be found on the peninsula of San Francisco, though they occur a few miles to the northward.

As we step upon the rocks we are saluted by numerous little jets of water, which take their origin from soft and seemingly shapeless masses beneath our feet. A more careful glance at these shows us that they are sea-anemones, for we catch sight of some that are partially expanded, and on searching a little farther we come upon a rock pool containing numerous individuals in a state of complete expansion. Beautiful objects they are, bright green tentacles on a bright green disc, and fully four inches across. It is curious that this large sea-anemone, together with two or three smaller species common in and around the Bay of San Francisco are still undescribed, unless they should prove identical with species described by Prof. Verrill from points northward or southward of our locality.

Two species of sponge gathered from the under sides of the rocks, some limpets (*Acmæa*), *Purpura saxicola*, *Chlorostoma funebrale*, and a small *Litorina* make up our total catch at this spot before the rising tide drives us back to the cliffs, where, in a recess damp with percolating water, we may capture four or five specimens of the rare Isopod, *Lygia dilatata* Stm. Everywhere upon the rocks, and in many places among the débris cast up by the tides, darting about swiftly in the sunshine and hiding in the crannies on our approach, we find its near relative *Lygia occidentalis* Dana; but *L. dilatata* is rare even in this locality, the only one in the neighborhood where I have met with it.

The stream running from Mountain Lake is made use of by the Spring Valley Water Co., and the flume conveying its water to San Francisco is carried along the face of the cliffs, bridging the ravines to Fort Point, and forms a convenient though narrow footpath. Along this route, a little later in the season, the sloping portions of the cliffs will be covered with the sweet-smelling wild

wall-flower, *Cheiranthus capitatus* Dougl., and the pretty red rock-cress, *Arabis blepharophylla*, but now, the rains just over, we only find green leaves.

In a hollow between the hills, where a tiny rillet is bordered with willows and dwarf shrubs of the blue ceanothus (*C. thyrsiflorus*), we see a flock of blue-birds, and pick up several red-bellied salamanders (*Diemyctylus torosus*) as they awkwardly sprawl among the wet herbage.

Descending to the beach at the fort we pick up among the débris cast up by the tide two species of those little jumping amphipodous crustaceans commonly called sand-hoppers, one kind (*Orchestia californiensis* Dana) is stoutly made, and is not found except near high tide level where it burrows in the sand in great numbers and hides beneath the wet débris; but the other species (*O. traskiana* St.) is more terrestrial in its habits, and may be found under heaps of dried grass and straw, dry horse-droppings, etc., at some distance from the beach.

On the under sides of the flat stones, wriggling along the wet surface and jumping actively when touched, we find a much smaller amphipod, less than half an inch in length, some of these we place in a bottle of sea-water, and on examination under the microscope at home are struck with the beautiful plumes of hairs which adorn the under side of the joints of the antennæ, and know that it is *Allorchestes plumulosus* Sb.

Along the edge of the rising tide we pick up two small jelly-fishes. They have little beauty and apparently little life when picked up, but after a few minutes in a large bottle of sea-water they begin to expand and contract their bells, a circlet of bright purple spots (ocelli) becomes conspicuous around the margin of the bell, and the tentacles all contracted when we pick them up, lengthen out until they reach from two to three times the height of the bell, which is about an inch. It is *Polyorchis penicillata* A. Agass., one of the loveliest of jelly-fishes. Large specimens of *Aurelia labiata*, a Discophorous medusa fully a foot across, with large purplish ovaries showing through the transparent bell, are floating upon the tide or stranded on the shore.

Leaving the shore we walk along the edge of a large pool in the salt-marsh between the Presidio and the sea; here a large flock of gulls is swimming; there are two species, one is the common yellow-billed *Larus occidentalis*, but the other, conspicuous from

the pure black and white of its plumage and its black bill, is *Chræcocephalus philadelphia* or Bonaparte's gull. The long slender bill and long pointed wings of this species give it a great resemblance to the terns, or sea-swallows, which it rivals in grace and beauty. From the farther end of the salt lake rises a beautiful large snowy-white bird, with long bill and lengthy legs trailing behind, this we believe to be *Herodias egretta* var. *californica* Baird. We watch its flight to the other end of the lake, where it alights and recommences its business of feeding on small crustacea, etc.

Evening is now closing in as we approach the cars at Harbor View, the little grebes scud homewards over the bay in squads of eight or ten, the brown pelicans flap heavily towards their roosting places, and the cormorants, one after the other, form a retreating line as they make off to their haunts on a more wooded part of the bay.

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PHOSPHORESCENT INSECTS. THEIR METAMORPHOSES.

BY MRS. V. O. KING.

ANIMAL metamorphosis is so uniform in its manifestations within certain limits, as to impart to its processes an apparent character of permanency. Whenever, therefore, we first observe any one of its phenomena which is beyond our experience, the curiosity is excited at what is rare, and we are led to inquire whether this new feature is anomalous, or whether it is not rather an exponent of capabilities hitherto dormant, but agreeably to law responding at the proper time to given conditions in the animal economy. The remarks of Mr. Wollaston, a few years since, on the relations existing between the apterous forms of insects and their atmospheric surroundings, and the further elaboration by Mr. Darwin of the method by which such results as the gradual modification of structures, etc., are attained, naturally occur to the student of these apterous phases of metamorphosis.

Among articulata representing the apterous types, there are probably no species more interesting than those embraced in the family of *Lampyridæ*, since they exhibit great diversity in their metamorphic traits. By their phosphorescent habit they enable

the inquirer to follow them throughout their developmental career to ultimate perfection in the imago; and in them also may be seen to commence anew the life cycle dating from the deposition of ova. This rare privilege of tracing insect metamorphosis is not afforded however, even under the most favorable circumstances, without great risk of self deception on the part of the investigator.

Of phosphorescent *Lampyridæ* in the south-western part of the Atlantic district I am acquainted with eight species; two of these have apterous females, which are also distinguished by other peculiarities. In this article I shall assume their origin from a common type, which by a series of progressive and retrograde steps have given rise to their present forms.

Buffon's assertion that "nothing in nature is so permanent as type," is well sustained in the known tendency of both plants and animals, when not influenced by extraneous causes, to return to an original model; while on the other hand this very inclination to resume a certain form implies a capability of change.

"Whenever," says Humboldt, "a new element develops itself in the feelings of mankind, it may almost invariably be traced to an earlier, deep-seated, latent germ." What this great writer said of the emotional nature, will probably apply with equal force to the development of physical structures and functions. The capability of adapting or evolving these is the "deep-seated, latent germ" which is a positive power residing in animal forms, only awaiting the given conditions of its action to produce apparent anomalies, and in some instances masked representatives of seemingly extinct races, constituting a reversion to their primitive type. This assumption of new powers is witnessed in the metamorphosis of any insect, and has led to a close scrutiny of life in its earlier or embryonic forms with a view to discover whether all the parts of the imago are present in the earlier period; many students of nature, perceiving the impossibility of effects without something more definite than a name for a cause, have thrown great light upon the subject.

Oken illustrates the gradual elevation in the scale of powers in the articulata by the metamorphosis of the *Lepidoptera*, which he says are born as worms, represent the crustacea in the pupa stage and finally attain true insect perfection in the imago.

Beginning at the lowest phase of animal perfection as assumed

in the apterous female of *Lampyris*, we may suppose this to be intermediate between the true larva and a higher form, the winged *Coleopteron*, of which latter Agassiz says, "they are scarcely more than worms, with certain structures and functions to suit their needs."

These aptera having a latent capability for higher development, in consequence of certain influences, differentiation begins, any apparent change having been preceded by imperceptible ones, such as the gradual concentration of nerves and muscular fibre in the wing-bearing segments. Rudimentary wings and elytra resulting from their fusion under constantly favoring circumstances, attain the maximum of their development in the hardier types of winged *Lampyridæ*. At a certain point we have male and female fireflies as the typically perfect insect.

Once having acquired wings an insect might by prolonged flight change its relations, and may thrive for a while in its new habitat. But either suddenly or by slow process its surroundings are changed. Climatic influences, after a time, test the powers of the winged articulate. Many insects may be presumed to perish, others modify their structures and functions, by non-use of some and development of others. By this course, which must be attended with great loss to individuals, incident to race preservation, some attain a degree of conservative perfection.

In some instances the more robust individuals which are able to contend successfully with the elements, like sturdy gymnasts who develop their muscles by muscular effort, gradually assume a still hardier habit, which is transmitted to their progeny in the larger and more powerful organs of flight, stronger manducatory organs and more fully developed eyes and feet. This evidently progressive phase may be coincident with apparently retrograde metamorphosis in some of the feebler members of the same family. The first tendency to degradation may be preceded by what is termed "an accident," a deformity occasioned by the insect's wings having been mutilated when rudely tossed against resisting objects by the winds. This peculiar feature appears in the offspring as an inherited shortening of the wings, it being well known that peculiarities acquired, or losses sustained, are not only transmissible to the progeny but frequently in an exaggerated form. The transition of an insect from an ærial life to that of an apterous creeper would, if gradual, be coincident with cor-

responding alterations in many of its parts in conformity with the new conditions of its existence. In accordance with the laws of adaptive evolution, large eyes, embracing great areas, either in pursuit or avoidance of rapidly-moving objects on the wing, being no longer of use in this degraded position, where they could neither aid the insect's flight nor assist it in procuring sustenance, would gradually be replaced by less globular ones with smaller lenses suited to nearer views. If this degradation were sudden it would be attended with great mortality; hence we find few beetles to be apterous, indicating, in my opinion, one of two probabilities, either that they are unable to sustain the rapidity of the change, or that being a comparatively recent evolution they have not yet attained numerical importance.

According to Mr. Felix Plateau, the centre of gravity differs in the larva and imago of insects, being effected by the coincident enlargement of the thoracic and the diminution of the abdominal segments. This fusion of segments and their ganglia, in view of the part they play in supplying the legs and wings with their suitable nerves of sensation and motion, having adapted the centre of gravity to given conditions, there would be a proper equipoise in all the parts. It can easily be seen that upon a change from the winged to the apterous type, if this were comparatively sudden, the body would be unwieldy, and the disproportion between the parts, rendering the creature's motions heavy, would tend to the non-use of the feet, and the consequent enfeebling of these members. Being unable to travel far in quest of food the insect would from necessity have less opportunity of feeding, thus aborting the manducatory organs from want of use. The chances of individual life being thus diminished the apterous female would no longer exist for herself but, supporting life from material probably stored up in the more active larval stage until she had deposited her eggs in a suitable nidus, would then expire, having completed her mission of race-preservation.

In thus treating of what might be expected from an insect having certain powers of adaptation, I have followed the order as indicated in the different characters seen in *Lampyris*. I have traced it in its supposed evolution from an apterous to that of an ærial being, and back to earth again as a creeper with heavy disproportioned body, feeble feet and mandibles, small eyes, and brilliant terminal segments.

As illustrating another phase of metamorphosis, I will mention a short-winged male which still retains the larger eyes and more brilliant pigment after they have probably ceased to be of service, pointing to its comparatively recent degradation, and illustrating what Dr. J. LeConte calls "a structure which has outlived its usefulness." The eyes are no doubt retained for awhile by inheritance, but we may safely conclude to be eventually modified.

The preceding remarks have applied only to structures and functions, but at each stage of change in these, corresponding variations have taken place in the coloring of different parts, from black to pale yellow.

In one species the strong-winged male is of a dirty brown, coarsely porous, and finely pubescent on the elytra. The apterous female is a pale buff, glabrous, concolorous; thus, in accordance with the laws appertaining to the different conditions, evolution was arrested in the apterous imago at the color series which belongs to the larva, apparently a simpler process than that which a change of color would imply. This possibility is intimated by Agassiz in his "classification upon embryological data" when he says that the beetle preserves the character of the larva of other insects, assuming only wings and more fully developed legs without reaching other successive metamorphoses. There are lesser stages as represented by the different species, enabling us to link the family in a successive chain from an original pair to this seemingly new creation. This is probably the resultant of an effort at race-preservation, a product of the wear and destruction of individuals into conditions which enable them to perpetuate their race until such time as shall favor their reversion to the original type. The more interesting phenomena of phosphorescence witnessed in this sub-family will be the subject of another article; and it may be proper here to remark, that the researches of the writer, both in the field and the laboratory, have been made, not with a view to fortifying any particular theory, but for the purpose of discovering truth as it is manifested in nature, and applying it to the ever-varying phenomena of insect life.

ON THE GENEALOGY OF PLANTS.

BY LESTER F. WARD, A. M.

ONE of the most remarkable anomalies, which the history of science and that of the human mind affords, is to be found in the appreciation which has been shown of the relationships which the different forms of life present. There has been no lack of acumen in discerning these relationships, in detecting the differences or recognizing the affinities, but there has been frequent failure to comprehend their meaning. The term relationship has been employed in a sort of metaphorical or metaphysical sense, as denoting mere resemblance wholly disconnected from any idea of natural dependence; as if the objects of nature were arbitrarily grouped into classes, orders and genera by the operation of some law of "pre-established harmony." It might be supposed that the term relationship, constantly in use in this sense, ought to have suggested the analogy to family, or *consanguineal* relationship among men, and led naturalists to seek to account for the resemblances observed among plants and animals on some such principle as that on which family resemblances are explained. Yet this simple deduction proved too profound for the human mind, and botanists and zoölogists went on accumulating facts down to the time of Lamarck, and most of them to that of Darwin, without perceiving their most obvious meaning. And there are still many who fail to perceive it, and who openly reject it when pointed out to them.

It is perhaps but proper to add that this state of things has not been wholly due to an inability to make rational deductions, but has been in part brought about by the existence of preconceived ideas which were sufficient to preclude all attempts to reason towards the true conclusion, however plain this course might appear to the unbiased mind.

But now that it is becoming generally recognized that the present forms of life are the true descendants of antecedent forms, and that the observed resemblances are the physical result of real or genetic relationship identical with that which makes children resemble their parents, it is but natural that old systems of classification should require to be entirely recast and moulded into harmony with this fundamental truth. Such, indeed, is the case, and already marked progress has been made, especially in zoölogy,

in which department chiefly, nearly all the most advanced workers in this field have concentrated their efforts.

In addition to other and greater benefits, this revolution has had the effect to relieve the systematists of the odium which naturally attaches to the apparently useless labor of classifying objects conceived as independent of one another. A dependence once established, classification becomes a vital process, and the only means of solving the highest of all scientific questions, that of the genesis of organic beings. Every fact in morphology or physiology, hitherto regarded too much as ends in themselves, now becomes an additional link in the chain of evidence which is to establish the genealogical history of a plant or an animal. Thus classification, formerly regarded as simply a means for the more convenient study of living things, becomes the highest object and chief end of biological investigation.

It is a matter of common remark that in the sudden advance of biological science which has taken place during the last eighteen years, it has been left for botany to bring up the rear. Prior to 1859 it was generally conceded that the science of plants occupied a considerably more advanced position than that of animals. This was due in the main to the impetus which it received at the hands of the Jussieus, who, following up the labors of Tournefort, had given to botany its so-called "Natural System."

But the Jussieus understood relationship only in the metaphorical sense, and maintained the fixity of species, and the system they established could not of course satisfy, in all respects, the law of genealogical descent. Its worst vice was the weighty authority which it acquired, and which became a serious barrier to its extension and rectification. But there are other reasons, existing in the nature of the two departments of biology, and which need not here be stated, that have contributed to permit our study of the vegetable kingdom to be outstripped by that of the animal kingdom. There has not, however, been wanting a deep sense of the inadequacy of the so-called Natural System of Plants, and in quite recent times its imperfections have become too obtrusive to be longer disregarded, even though greatly reduced by the labors of Lindley, DeCandolle, Hooker, Gray and others; and an effort has already been commenced, especially on the continent, to subject that system to a thorough criticism, with the aid of the new light which the modern school of biology has kindled in all its departments.

I do not propose in this paper either to review the literature of this subject, which is already becoming voluminous, or to attempt, among the many conflicting theories advanced, to reconstruct the natural system, but shall seek rather, in the light both of the new facts and the new principles already accepted, to state some of the objections to the received classification, and sketch, in its most general outlines, the form and direction which I conceive that the approaching reform is most likely to assume.

Probably the most objectionable feature of the system of classification proposed by Jussieu and still adhered to in nearly every systematic work on botany, is the position of the Gymnosperms. These constitute a sub-class of the Exogens and are made co-ordinate with the sub-class Angiosperms, which only embraces the Dicotyledons proper, or true flowering Exogens.

This arrangement and terminology involves a number of grave inconsistencies. In the first place the so-called Endogens or monocotyledonous plants are as truly Angiosperms as are the plants to which that term has been thus specially applied, the pistil consisting in both cases of a closed ovary. The Gymnosperms, therefore, in the present system are placed between the two great divisions of the Angiosperms and made to interrupt the natural series. The most casual observation, both of the foliage and the flowers, shows how awkward this position is, and indicates without closer scrutiny, that the Gymnosperms are out of place. Moreover, the enclosure of the germ is what chiefly distinguishes the phænogamic from the cryptogamic series, and the degree to which this is accomplished should mark the degree of advancement from the cryptogamic state. But we shall presently look deeper into this phase of the question.

In the second place, the reason assigned for the position of the Gymnosperms is the exogenous structure of their woody tissue. This argument might have some force if only the *Coniferæ* were embraced in the sub-class; but when we consider the *Cycadaceæ*, which equally belong there, a difficulty arises. Here the woody tissue assimilates almost altogether that of the endogenous palms or cryptogamic tree-ferns.

Again, the wood of the *Coniferæ* is by no means identical with that of the true Dicotyledons. It is destitute of the continuous vessels called ducts with their minutely porous joints, so characteristic of the former. The secondary wood consists, with the

exception of the medullary rays, entirely of large tubes, called *tracheïdes*, occupied with large prosenchymatous cells, which latter are nearly of uniform shape, while in the true Dicotyledons the tissue is in part parenchymous and the cells much more numerous and varied in form; moreover, the small circular areas enclosed between the walls of adjacent cells or *tracheïdes* are much more numerous and pronounced, especially in old tissue, in the *Coniferæ* than in the Exogens proper.

There is still a third important respect in which the Gymnosperms differ from the remaining Exogens in a marked manner. This is in the number of cotyledons, which is here usually more than two and sometimes as many as fifteen, while in true dicotyledonous plants the number is uniformly two; only a very few exceptions having ever yet been found; as, for example, in *Ranunculus ficaria*, which usually has but one, and in some species of *Phaseolus*, which sometimes have a whorl of three.

The objections above enumerated to the position of the *Gymnospermæ* in the prevailing system are quite independent of any recent facts pointing to their origin and derivation, and would be equally applicable under the old metaphorical conception of relationship. It is, therefore, all the more strange that it should have survived so long and should have required the argument from descent to finally break it down.

Evidence of this nature, however, is not now wanting, and it very plainly points to the direct *filiation* of the Gymnosperms upon the Cryptogams. This evidence concerns two important sets of characters, the woody tissue and the reproductive organs. As regards the former the close resemblance of the *Cycadaceæ* to the arborescent ferns is very obvious from a glance at a cross section of each. If this character, therefore, possessed the importance which is claimed for it, it would be found more difficult to pass from the *Cycadaceæ* to the *Coniferæ* than from the latter to the Dicotyledons. And we shall hereafter see that great liberty has been taken in thus grouping the *Cycadaceæ* and *Coniferæ* together.

If we consider the *Coniferæ* alone there is one class of facts recently brought to light which possesses an unusual interest. The investigations of Prof. Williamson[1] have shown that the trunks of *Lepidodendron*, exhumed from the coal beds of England,

[1] On the Organization of the fossil plants of the coal measures. Phil. Trans., 1872.

exhibit a species of exogenous growth. This differs not only from that of the existing pines and from that of the true Exogens, but also from that now known to take place in certain monocotyledonous plants and constitutes a sort of fourth type. It consists, so far as understood, in the formation of a layer of growing tissue with dividing cells (*meristem*) around each fibro-vascular bundle, the continuous division of whose cells necessitates a radial or centrifugal increase of the entire stem. A similar structure on a small scale occurs in certain now living cryptogamic forms, as in *Botrychium*, *Isoëtes*, etc. This form of exogenous growth may perhaps be regarded as marking a transition from the endogenous structure of most cryptogamic stems to the form of exogenous structure which prevails in the *Coniferæ*, but which has not been transmitted to the branch from which, on the hypothesis of descent, the *Cycadaceæ* have been developed.

The transition in the reproductive system is far more obvious and remarkable. What is known as "alternate generation," so long familiar to zoölogists, is now found to prevail throughout the greater part of the vegetable kingdom. It is most apparent in the higher Cryptogams, especially in the mosses, ferns, *Equisetaceæ* and *Lycopodiaceæ*. In all these the final stage is the production of a plant or "generation" capable of developing spores, which are of both sexes, and produce the sexual plant. Among the vascular Cryptogams there are two orders, one the *Rhizocarpeæ* in the fern group, the other the *Ligulatæ* in the club-moss group, in which the final spore-bearing stage is sexually differentiated. These produce two kinds of spores, called respectively, from their relative size, *macrospores* and *microspores*, the former of which develops a female, and the latter a male *prothallium*, or sexual plant. This *prothallium*, which in most vascular Cryptogams is an object of considerable size, and which corresponds to the entire leafy portion of the mosses, liverworts and other cellular forms, continues to diminish as the degree of organization increases; the spore-bearing generation, on the contrary, increasing in a corresponding ratio; the large fronds of a fern representing only the seta and capsule, or fruiting portion of a moss. In the *Rhizocarpeæ* and *Ligulatæ*, whose macrospores and microspores indicate a higher organization, this reduction of the sexual generation is carried so far that the *prothallium* scarcely protrudes from the spore, or is wholly confined within it. Hoffmeister[1] has

[1] Vergleichende Untersuchungen, 1851.

long ago pointed out the true significance of these facts, and shown that we have only to continue this same process a step beyond what it has already reached in *Salvinia* and *Isoëtes* to arrive at the condition presented by the existing Gymnosperms, the *Cycadeceæ* and *Coniferæ*. Here the macrospore exists under the name of embryo-sack, while the microspores are the pollen-grains. The so-called *macrosporangia* of these highest Cryptogams thus correspond to the ovules[1] of the Phanerogams, while the anther-cells of these latter are homologous with the *microsporangia* of the former. The *prothallium* is readily traced to the Gymnosperms, especially in the fertile flowers, where it re-appears under the name *endosperm*, and constitutes the albumen or reserve material of the future seed — one of the finest examples in biology of the fundamental identity of the reproductive and nutritive functions. In the staminate flowers the *prothallium* may be considered as represented by the *pollen-tube* (the elongated cell that descends from the pollen grains into the ovary and fertilized the germ), although a careful study of the microspores of *Isoëtes*, in which one cell remains sterile while the rest develop the *spermatozoa*, may leave some doubt as to whether the homology is here quite complete. The greatest differentiation has gone on in the microspores; the microspores and the plants and organs bearing them, still presenting, in many cases, a striking resemblance. In the *Cycadaceæ*, for example, the anther-cells are sessile and single or in groups upon the lower surface of the broad filaments like the "fruit dots" on the back of a fern. In the *Coniferæ* the stamens are less leaf-like, but the pollen-sacks are often solitary and scattered over the under surface of the flattened filaments.

An interesting similarity also exists between the male aments of certain *Taxaceæ*, as in the yew and the juniper, and the spikes of *Equisetum*, the horse-tail or scouring-rush. In these cases it is said that nearly all the morphological homologies are satisfied.

In general it may be said that in all these respects the *Cycadaceæ* resemble most the group of true ferns, the *Coniferæ* proper (pines, firs, etc.), most the club-moss group (Dichotomes), and the

[1] Sachs (Yahrbuch der Botanick, 4 Aufl. S. 481) justly objects to the term ovule (or little egg) as entirely misleading in its etymology, and as tending to perpetuate the error that gave rise to its use, and proposes the term seed-bud (Samenknospe) as a substitute.

Taxaceæ, most the *Equisetaceæ;* a fact of great importance for the genealogy of plants, and to which we shall have occasion to refer again.

Upon the whole, therefore, it seems to be no longer open to serious doubt that both of these widely dissimilar orders of the *Gymnospermæ* (*Coniferæ* and *Cycadaceæ*), as also probably the *Gnetaceæ*, have been directly developed out of lower forms of cryptogamic vegetation. They should, therefore, certainly occupy a position at the base of the phænogamic series. Whatever may be ultimately accepted as the mode of transition from the Gymnosperms to the Angiosperms, it seems to be established that the former have actually descended from the latter, and they should therefore be all assigned a higher place in the scale of organization.

It is one of the misfortunes of botanical science that above the cellular plants no classification based on histological structure can be made; so nearly identical are the forms of structure through which all classes of vegetation pass. It is therefore necessary to depend in the main upon differences of the reproductive system, as affording the best characters by means of which to trace the development of vegetable forms. The Gymnosperms, no less than the Angiosperms, have both classes of structure, and we may almost say the same for the Cryptogams. But from the Cryptogam to the Gymnosperm, and from this to the Angiosperm, there is a continuous advance in one direction toward the complete protection of the germ as it is accomplished by the perfect ovary. It is indispensable, therefore, that all plants possessing this important character should be erected into one great group or class, and that from this group all plants to which this character does not belong be rigidly excluded. The terms *endogenous* and *exogenous* being common to both Angiosperms and Gymnosperms, should be excluded from the classification, or only employed to mark the subordinate divisions. The two systems of classification for the phænogamic series may therefore be thus compared:

OLD SYSTEM.

- Phænogams
  - Exogens
    - Angiosperms
      - Polypetalæ
      - Monopetalæ
      - Apetalæ
    - Gymnosperms
      - Gnetaceæ
      - Coniferæ
      - Cycadaceæ
  - Endogens

NEW SYSTEM.

- Phænogams
  - Angiosperms
    - Dicotylæ (exogenous)
      - Monopetalæ
      - Polypetalæ
      - Apetalæ
    - Monocotylæ (endogenous)
  - Gymnosperms
    - Gnetaceæ, Coniferæ — exogenous
    - Cycadaceæ (endogenous)

The terms *Monoctylæ* and *Dicotylæ* are preferable to *Endogen* and *Exogen*, for the Angiosperms, since they lead to no confusion with the class *Gymnospermæ*. In this classification the terms conform to the strict rules for definition, each being wholly exclusive of all the rest. The reason for transposing the *Polypetalæ* and *Monopetalæ* will be given in another paper.

Before proceeding to consider more especially the manner in which the Angiosperms may have been derived from the Gymnosperms, it will be necessary to glance once more at the nature of the cryptogamic vegetation from which we suppose the latter to have descended. And for our purpose we may conveniently divide it into three groups: 1st, the group of true ferns; 2d, the

group of the club-mosses; and 3d, the horse tail group, or *Equisetaceæ*. The first of these groups seems to have come down to us from the Carboniferous epoch almost in an unchanged condition, trunks of tree-ferns quite similar to those still found growing in tropical countries having been exhumed from the coal measures. The second group must be made to embrace the ancient *Lepidodendron*, which flourished so abundantly in that luxuriant age, and whose resemblance to both our club-mosses, and to the proper Conifers has been so frequently remarked. In this group, therefore, there must have been great degeneracy, as of it the forests of that period seem to have been chiefly composed, while nothing now remains but the low herbaceous and moss-like plants that form our *Lycopodiaceæ*.[1] To the third group belonged the famous Calamites of the coal beds, and these too have dwindled into insignificant rushes.

Such is in fact the fundamental division of the cryptogamic series, and is based as well upon differences of internal constitution as of external aspect. If we associate these three classes of Cryptogams, respectively, with the three orders of the Gymnosperms, *Cycadaceæ*, *Coniferæ* and *Gnetaceæ*, we shall be able to discern many remarkable resemblances which, while they may really signify nothing, are sufficient at least to suggest an hypothesis. In the first group, or that of the true ferns, we have in the existing *Rhizocarpeæ*, to which our *Azolla* belongs, and of which the genera *Salvinia*, *Marsilia*, and *Pilularia* have been carefully studied, an undoubted transition towards the general condition presented by the *Cycadaceæ*. It is not unfavorable to this theory of transition that the existing forms indicating it are small and humble plants. The slight differentiation of the sexless spore into the macrospore and microspore could of itself have scarcely given the new form a special hold upon its environment, and we may almost wonder that this intermediary stage should not have succumbed altogether, as all the later ones probably have done. But the true phænogamic or flowering state once reached, permanence was acquired, and with it the power of attaining a higher development. It is remarkable that this differentiation affected the reproductive system only, and has left the woody tissue and also the foliage of the fern and the Cycad to a great extent unchanged.

[1] In the Sunda Islands there is a Lycopod that attains a diameter of six inches and a height of twenty-five feet.

That the *Coniferæ* proper (*Abietineæ*) have descended from the second or club-moss group, seems even better established than that the Cycads have sprung from the ferns.

The affinities of the extinct *Lepidodendron* with this group have always been recognized. Those who claim for *Lepidodendron* a Coniferous character only strengthen this view by showing how closely the two groups approached each other in those ancient times. The Araucarian pine of the southern hemisphere is even now covered with scales over its entire surface, and presents no small analogy with the *Lycopodiaceæ* and with what is known to have been the character of *Lepidodendron*. We must, therefore, regard *Araucaria* as our nearest living representative of the early transition form through which the Pine family was derived from the Carboniferous Lepidophytes. And it is especially interesting to remark that it is just this Araucarian group of true Conifers which we find associated with the arborescent cryptogamic vegetation, and whose scaly trunks lie side by side with the equally scaly trunks of *Lepidodendron* in the coal formation—a fact which shows at how early a period the differentiation began, and how little progress has been made within the same group during subsequent geologic ages.

With regard to the great advance which must have been made in passing from the crytogamic to the gymnospermous reproductive system, the evidence has already been briefly referred to. To the *Rhizocarpeæ* in the fern group correspond the *Ligulatæ* in the club-moss group, in which the asexual spore is completely differentiated into the sexual macrospore and microspore. In this order the only two genera thus far known, *Isoëtes* and *Selaginella*, have been faithfully studied by the foremost botanists of Europe, and the facts repeatedly verified. Hoffmeister's generalization, which is of the highest importance and has been generally accepted, has already been adduced, and its direct bearing on the immediate question need scarcely be reaffirmed.

The origin of the *Gnetaceæ* is far more obscure, and indeed so few positive facts have been brought forward to establish it that all speculation may be pronounced idle. That there is considerable general resemblance between the genus *Ephedra* and certain branching species of *Equisetum*, cannot be denied, but this similarity of habit is not accompanied by any corresponding similarity of structure either in the tissue or in the fruiting apparatus, while

the few genera which have been grouped under this order vary enormously in everything but their mode of inflorescence. Whether they have been developed independently from the Cryptogams or have been off-shoots from lower Gymnosperms must therefore remain one of the problems of botanical science; but it is a problem, as we shall presently see, which derives its great importance from the special *rôle* which the *Gnetaceæ* have been made to play, as a connecting link between the Gymnosperms and the Dicotyledons.

The highest marks of organization in the vegetable kingdom are the exogenous structure and the encasement of the germ. These may be regarded as the two great ends towards which vegetal life is perpetually striving. One of these ends is attained by the *Monocotylæ* or endogenous Angiosperms; both of them have been secured in the *Dicotylæ* or exogenous Angiosperms.

Although most of the intermediate stages, from the naked-seeded Cycad to the closed ovary of the Monocotyledon, have been obliterated, or have not been discovered, the evidence is nevertheless abundant that such a transition has taken place. If we consider what may be called their *physiognomy* alone, the descent of the true palm from the sago-palm, or both from a common ancestor in the *Cycadaceæ* would seem in a high degree probable. The great divergence in the matter of floral envelopes may be accounted for on the supposition that the differentiation, as is known to be frequently the case, was chiefly confined to the reproductive system and only slightly affected other characters. The absence of intermediate stages in our existing flora could then be explained by the now well understood law of the ephemeral nature of transition forms. In fact the Cycad is itself a transition form connecting the Cryptogams with the true flowering plants, or Angiosperms, and as such it is doubtless a comparatively ephemeral state. So far as general aspect or physiognomy is concerned, the ordinary observer, without trained scientific insight, naturally and instinctively classes the palm, the sago-palm, and the tree-fern in one and the same group, little imagining that botanists class them each in such a widely different group. Language itself builds on so obvious a resemblance. What we call the sago-palm, connecting it with the higher type, the Germans call the palm-fern (*Palmfarn*), connecting it with both the higher and the lower types of vegetation. Should further study

of these forms, in the light of the broadest principles of classification, lead the technical botanist to a recognition of their genetic relationship, and thus bridge over the two great chasms in the vegetable series, it would not be the first time that vulgar observation has been found to accord with true science after a long period of unmerited disdain.

The fact that the leaves of the *Cycadaceæ* grow from a terminal bud like the palms, while they unfold from the circinate apex like the ferns, shows that this resemblance to both palms and ferns is not altogether fanciful or purely superficial; in fact their genetic development from the latter, as already shown, is established by other evidence of the most vital character based on the morphology of the reproductive organs. It is therefore probable that the *Cycadaceæ* are not only more nearly related both to the *Palmaceæ* and the *Filices* than is generally supposed, but that they are less nearly related to the *Coniferæ* than is implied by their position in the received system of classification.

The wood of the *Cycadaceæ*, as already stated, consists of a mass of sheathed fibres in a large central pith composed chiefly of large prosenchymatous cells, and if not identical with that of the palms and arborescent ferns, certainly resembles this far more closely than it does that of the exogenous Gymnosperms. The similarity in the mode of flowering without which such a position could never have been thought of, may perhaps have been accidental, the two widely divergent lines of vegetation passing through some of the same transition stages in their progress towards the ideal type of vegetal perfection. The evidence already adduced of the derivation of the *Coniferæ* from a distinct stock of Cryptogams, to which the *Lepidodendron* belonged, would seem to corroborate this view, and this quite independently of the real origin of the *Dicotylæ*. Nor should botanists despair of still finding plain traces, in the transformations of the floral organs, of the descent of the *Monocotylæ* from the *Cycadaceæ*, and with this view the embryological study of the *Palmaceæ* cannot be too strongly urged.

The proper origin of the *Dicotylæ*, notwithstanding their possession of a closed ovary in common with the *Monocotylæ*, is a problem which presents the gravest difficulties to the genealogical systematist. Their derivation from the latter, though not wholly without legitimate evidence, is far from established, and may have to be altogether abandoned. The facts which support this hypothesis may be thus briefly summed up:

The endogenous structure of monoctyledonous stems is of two classes. In the palms, as in the *Cycadaceæ* and arborescent ferns, the foliage springs from one terminal bud which attains its full development before expansion, after which no further lateral enlargement of the stem takes place. This may be regarded as the normal form of endogenous growth. But another form is found in the trunks of the arborescent *Liliaceæ*, as in *Dracena*, *Yucca*, *Aloë*, etc., which may be regarded as representing an advance in the direction of an exogenous structure. The stems of these tree-like *Liliaceæ* actually undergo increase in size, or radial growth, after emerging from the bud. This takes place by the formation of a growing tissue (*meristem*) within the outer bark at certain distances below the terminal bud, which increases in thickness for some time before passing into permanent tissue, and effects an enlargement of the stem on all sides. A cross section of one of these trunks reveals a number of rings of this modified tissue, some of which are far internal, though at the time of their formation they must have formed the inner bark of the tree.

Although this is clearly an advance towards the true exogenous structure, it seems to be rather by way of analogy than of direct progress, the same end (power of strengthening the trunk to resist the force of gravity and of the elements and thus to render greater size and longevity possible) being attained, but by the adoption of a somewhat different means.

There is another group of plants, wholly different from those just described, which also afford considerable evidence of forming a transition stage from the endogenous to the exogenous structure. These are the aquatic plants. Sanio observes that in *Potamogeton* and other aquatic and submersed Endogens, "an axial bundle extends continuously through the stem, the bundles from the leaves only subsequently uniting with it," "a condition," says Sachs, "quite anomalous in monocotyledonous plants, but also found in dicotyledonous water plants, particularly in the *Nymphæaceæ*." Such a condition found among aquatic plants is certainly very interesting in view of the probable aquatic character of all primordial vegetation, but whether these facts possess any real significance in connection with the question of the origin of the Dicotyledons still remains doubtful.

In the venation of leaves of monocotyledonous plants, which is usually parallel, there are to be observed marked approaches

towards the reticulated structure which prevails with the *Dicotylæ*. Every one is familiar with many cases of this kind, as in *Dioscorea*, *Goodyera*, etc., while on the other hand, approaches to the parallel venation sometimes occur in the *Dicotylæ* (*Plantago*, etc.).

A far greater difficulty is presented by the cotyledons; for while there are a few cases in which exogenous plants develop but a single cotyledon, I am aware of no case in which an endogenous Angiosperm has been found to develop more than one. It is, however, presumable that a more complete investigation of this question may reveal transition forms here as elsewhere.

Such are the principal facts thus far made known which tend to encourage the hope of ever tracing the higher class of Angiosperms back to an origin within the lower class.

Far more satisfactory is the evidence that the Dicotyledons have been developed out of the *Gnetaceæ* and perhaps indirectly out of the *Coniferæ*. The *Gnetaceæ*, a small but interesting family of only three known genera (*Gnetum*, *Ephedra*, and *Welwitschia*) possess all the marks of forming a true intermediate link. The flowers of both sexes are provided with a sort of half-envelope, called the *perigonium*, which surrounds and protects the anther-bearing filament in the male, and the solitary ovule in the female flower, and may be regarded either as a rudimentary ovary or as a rudimentary perianth.

It is worth remarking here that the chasm between the Gymnosperms and Angiosperms is at all points greater with respect to the floral envelopes (including the ovarian) than with respect to the process and true organs of fertilization. The ovary of the Angiosperm is enclosed in an envelope, in the true Gymnosperm it exists but is exposed, in the *Gnetaceæ* it is half enclosed and half exposed. It matters not whether the *perigonium* be regarded as the homologue of the ovarian envelope or of the outer floral envelopes of the Angiosperms, since all the floral organs, including even the essential ones (stamens, pistils, etc.) are simply modified leaves. In the passage from the *Cycadaceæ* to the *Palmaceæ* no such connecting link has yet been discovered, and for the truth of such a transition we must rely upon the remarkably strong physiognomic resemblance coupled with the evidence furnished by the structure of the tissues and the mode of æstivation. The *Gnetaceæ*, however, while they give us this invincible evi-

dence of a transition in the rudimentary ovary, would seem at first view to afford no physiognomic mark to indicate the point at which the chasm was bridged over. There is one family of Dicotyledons, however, which, though little familiar to the inhabitants of the northern hemisphere, are none the less likely to have completed this transition, and in which there certainly is a strong physiognomic resemblance to at least one genus of the *Gnetaceæ*. Humboldt,[1] speaking of the remarkable form of the *Casuarineæ* of the East Indies, describes them as "trees with equisetum-like branches," and remarks that "Plumier's *Equisetum altissimum*, and Forskal's *Ephedra aphylla* of North Africa, are forms nearly allied to *Casuarina*." This physiognomic resemblance of *Ephedra* to both *Casuarina* and *Equisetum* is certainly very interesting, not only as affording a provisional hypothesis for explaining the transition from the Gymnosperms to the *Dicotylæ*, but also as marking out a line of investigation with a view to determining the origin of the *Gnetaceæ*. But to this we shall revert.

Not only do the *Gnetaceæ* thus approach the *Dicotylæ* in their reproductive system, but they also present a corresponding advance in the formation of the secondary wood from the structure of the *Coniferæ* towards that of the true Exogens. Besides the *tracheïdes* of the former it also contains vessels closely resembling the porous ducts of the latter.

Should the descent of the *Dicotylæ* from the *Gnetaceæ* be accepted as probable, it would only remain to determine the origin of the latter in order to complete a rough outline of the entire genealogy of vascular plants.

As already remarked, the attempt to affiliate them upon the *Equisetaceæ*, as a third independent branch of the Cryptogams, cannot be seriously made in the present state of science, notwithstanding the singular harmony in the general aspect of *Ephedra* and *Equisetum*. The fact heretofore pointed out, however, that a striking analogy subsists between the spikes of *Equisetum* and the male aments of *Taxus* and other allied genera, may be taken as a faint indication of what may have been the mode of development of these forms. It should at least be remarked that within the *Coniferæ* there is exhibited no small degree of progress towards certain leading characteristics possessed by the Dicotyledons. From the lowest to the highest,

[1] Ansichten der Natur, Stuttgart, 1871, p. 187.

from the Araucarian pines to the yew trees, such progress is well marked, and in *Salisburya*, the Japanese Ginkgo, which is related to the yew, the foliage comes at length to closely resemble that of many exogenous Angiosperms. The suspicion has even been expressed that all the genera of the *Coniferæ* may not have sprung from the same parent stock.

The origin of the *Dicotylæ*, which constitutes the chief problem in the genealogy of plants, is thus seen to be one which, while it admits of several possible solutions, nevertheless, in the present state of science, certainly admits of no positive solution. Whatever hypothesis we adopt, if we suppose a *monophyletic* origin for all plants, the derivation of both branches of the *Angiospermæ* from this common root will involve what may be thought to be a violent assumption. If the endogenous Angiosperms have developed out of the *Cycadaceæ* and the exogenous Angiosperms out of the *Gnetaceæ*, it requires some stretch of our credulity, in view of the bad repute into which all alleged "analogous" organs have in recent times fallen, to admit that the closed ovary, so identical in the two classes of plants, could have been arrived at from two such independent sources. To avoid this difficulty, which no one knows better how to appreciate, Prof. Hæckel suggests the probability that the Angiosperms as a class were first developed from the *Gnetaceæ*, and that subsequently they subdivided into the monocotyledonous and the dicotyledonous branches.[1] But with due deference to so high an authority, it is submitted that this would involve a still more violent assumption, viz: that an endogenous structure was derived from an exogenous one. Besides, we fail to find a single fact either in morphology or in palæontology to support this hypothesis. Again, if we seek to trace the genealogy of the *Dicotylæ* back through the *Monocotylæ* to the *Cycadaceæ*, we are driven to the equally forbidden presumption that the exogenous structure of the *Dicotylæ* and of the *Coniferæ* and *Gnetaceæ* was independently reached. There is, therefore, no serial line by following which all these difficulties can be escaped.

Those to whom all these instances of so-called "teleology" present no serious obstacle, may even find satisfaction in the conception that not only are the *Coniferæ* descended from two different parent stocks and the *Gnetaceæ* from still a third, but

[1]Schöpfungsgeschichte, Aufl. 5, Berlin, 1874, S. 430.

that the *Dicotylæ* may themselves be of heterogeneous origin, part of them being descendants of the *Coniferæ*, part, of the *Gnetaceæ*, and part, of the *Monocotylæ*. Should it ever become generally believed that the *Dicotylæ* are of multiple origin, the interest, now so great, in the true arrangement of the families of this class of plants would be greatly increased, and more satisfactory answers to many puzzling questions might be expected.

Perhaps the least objectionable of all the theories advanced, as that which requires the least extreme or improbable assumptions, and affords the greatest relief from the dilemma, is that which maintains the two great co-ordinate branches or parallel ascending series of the vegetable kingdom intact and independent from the most remote period to which they are traceable in the past history of the globe, and sees in the development of the endogenous and exogenous Angiosperms at the summit of each, respectively, the simple attainment in both of one of the great ends of vegetable existence, without which the highest functions of plant life cannot be manifested.

If we believe in the evolution of organic forms at all, we must accept that of vegetable forms, and if we are convinced that the higher plants are the descendants of lower ones, we ought by this time to have at least some provisional hypothesis as to the way in which this process of evolution has been going on in the vegetable world. We should not go on accumulating facts forever without attempting to make any use of them. In this age, when the law of descent has reached, in zoölogy, its exact stage, the stage of prevision and prediction, it is certainly time that some of the operations of this law were recognized and studied in the cognate kingdom of plants. The utmost that can be objected to any present attempt to trace the genealogy of plants, is, that the precise truth has not been reached, and those who are really competent to raise this objection must be competent to present a nearer approximation to the truth, which is the very service which science most needs. It is, therefore, with a full sense of the imperfection and inherent objectionableness of the scheme, and an entire willingness to see it superseded by one which shall better satisfy all the facts of science, that the one here rudely sketched is submitted. Stripped of all its complicating conditions and qualifications, many of which have been referred to and explained, this scheme of genealogy

may be more clearly presented by means of the following rough diagram, in which not only are all additional coördinate branches left unrepresented, but the continuation of each stage beyond the point of divergence is, for the sake of perspicuity, removed, leaving the differentiations only to stand in naked outline. This diagram presents the two great lines of descent, that of the Lepidophytes, of which we have the fossil genus *Lepidodendron* in the Carboniferous, and that of the ferns, trunks of whose arborescent forms are also found in the same formation. The line of the *Equisetaceæ* is omitted, although it probably had an independent existence, and may yet be found to have a genectic connection with some of the higher types.

The order of succession here laid down is confirmed by what is known respecting the time at which each of the several groups first appeared in the geological history of the globe. The primary divergence must have taken place in the latter part of the Devonian age, since within this formation occur some remains of *Lepidodendron*, while fossil trunks both of this and of true tree-ferns are found throughout the Carboniferous strata. It was in this latter epoch that both the ferns and the Dichotomes or Lycopodites attained their greatest perfection and abundance. Whether any of the large trees belonging to either of these groups had advanced to the stage now represented by the *Ligulatæ* and *Rhizocarpeæ*, there is no means of knowing, but that this stage was reached in both the great lines during the Carboniferous epoch must follow from our hypothesis, since it is within this epoch that both the *Coniferæ* and the *Cycadaceæ* first made their appearance, and during which they attained to very much the proportions and general character which certain forms of them still present. These forms advanced at a parallel rate and both reached the point of greatest development and supremacy at about the same time in the Triassic and Jurassic periods. They are both at the present time clearly on the decline, especially the *Cycadaceæ*, which are on the open road to early extinction before the march of higher types of vegetation. The palæontology of the *Gnetaceæ* is little known, but they have been supposed to have originated in the later Permian, or in the Trias. They constitute at best but a transition form, and are not sufficiently abundant to be likely to be discovered in a fossil state. It is a remarkable fact that the earliest remains of both the *Monocotylæ* and the *Dicotylæ* have been found

DIAGRAM SHOWING THE SUPPOSED LINES OF GENEALOGICAL DESCENT OF VASCULAR PLANTS.

LINE OF THE LEPIDOPHYTES.

LINE OF THE FERNS.

in the same formation, viz: the Chalk, and although their first actual appearance may date back into the Jura or Trias, it is probable that in point of time the two great classes of Angiosperms had a nearly simultaneous origin. Whether either of these great vegetable types has reached its highest destiny on the earth it is impossible with certainty to affirm, but the indications are that, for the *Dicotylæ* at least, progress in organization is still going on.

In order to complete the systematic survey of the vegetable kingdom from the point of view of genealogical descent, the following logical scheme of classification is appended for comparison with the genealogical scheme presented on a preceding page:

- **Phænogams**
  - **Angiosperms**
    - Dicotylæ (exogenous)
    - Monocotylæ (endogenous)
  - **Gymnosperms**
    - Gnetaceæ, Coniferæ (exogenous)
    - Cycadaceæ (endogenous)
- **Cryptogams**
  - **Lepidophyta**
    - Dichotomeæ
      - Ligulatæ
      - Lycopodiaceæ
    - Equisetaceæ (?)
  - **Filicineæ**
    - Rhizocarpeæ
    - Filices

THE MODE OF EXTRICATION OF SILKWORM MOTHS FROM THEIR COCOONS.

BY A. S. PACKARD, JR.

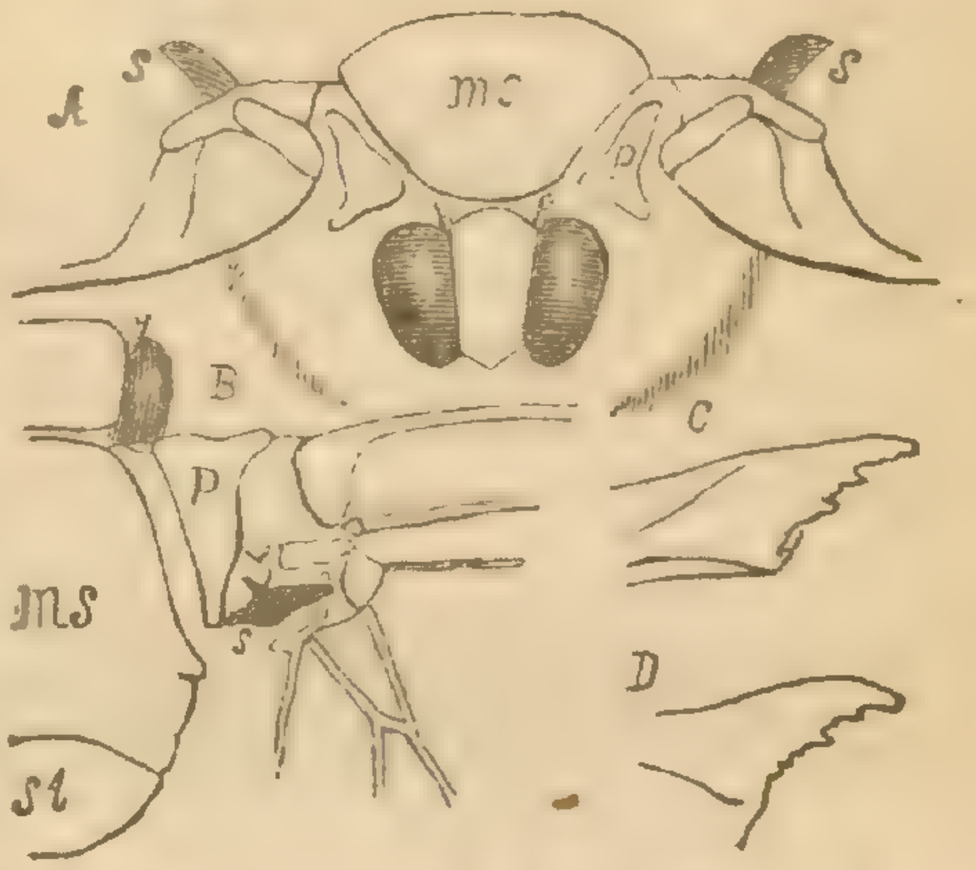
WITHOUT having made extended research in the literature of entomology, the only account which we have been able to find of the mode of extrication of the silkworm moths from their cocoons is that given by Kirby and Spence in their chapter on the pupa state of insects, vol. iii, pp. 280–283, which is quoted below, as it gives a summary of what was known up to the year 1828, while so far as we are aware nothing has since then been recorded on this interesting subject, except the observations of Mr. L. Trouvelot (AMERICAN NATURALIST, vol. i, pp. 33, 34); the brief statement in Lacordaire's Introduction a l'Entomology (1834, p. 201) being evidently based on Réaumur's observations.

The texture of the cocoon of the silkworm moth is uniform in every part, and the layers of silk are equally thick at both ends. The moth makes its way out by cutting or breaking these threads at the end opposite to its head; an operation which, as it destroys the continuity of the silk, those who breed these insects are particularly careful to guard against, by exposing the cocoon to heat sufficient to destroy the included pupa. The question is, what instruments does the moth employ to effect this? And this we are not able to answer satisfactorily. Malpighi asserts that the animal first wets the silk with a liquid calculated to dissolve the gum that connects the threads, and then employs its lengthened head to push them aside and make an opening. But, as Réaumur has observed, besides that so obtuse a part as the head of a moth is but ill-fitted to act as a wedge, we find the threads not merely pushed to each side, but actually cut asunder. He therefore infers that the eyes, which are the only hard organs of the head, are the instruments by which the threads are divided—their numerous minute facets serving the purpose of a fine file It should be observed, however, that Mr. Swayne confirms Malpighi's assertion that the silk worm does not cut but merely pushes aside the threads of its cocoon, and he informs us that he has proved the fact by unwinding a pierced cocoon, the thread of which was entire. Yet Réaumur's correctness cannot be suspected, and he affirms that from observation there can scarcely be a doubt that most of the threads are broken; which is further confirmed in an account of the breeding of silkworms published in the American Philosophical Transactions, in which it is expressly stated that cocoons out of which the fly has escaped cannot be wound. Analogy, it must be confessed, is against Réaumur's opinion, since other kinds of silkworms make their

escape by means of a *fluid*. Thus we are informed by Dr. Roxburgh that *Attacus paphia* when prepared to assume the imago, discharges from its mouth a large quantity of liquid, with which the upper end of the case is so perfectly softened as to enable the moth to work its way out in a very short space of time, an operation which, he says, is always performed in the night. Perhaps the two opinions may be reconciled by supposing the silkworm first to moisten and then break the threads of its cocoon. In those that are of a slighter texture, a mere push against the moistened end is probably sufficient, and hence we find in so many newly-disclosed moths the hair in that part wet and closely pressed down. If it be apparently difficult for the silkworm moth to effect an opening in its cocoon, how much harder must seem the task of the puss moth (*Cerura vinula*) to pierce the solid walls of its wood-thickened case? Here the eyes are clearly incompetent; nor could any ordinary fluid assist their operation, for the gum which unites the ligneous particles is indissoluble in aqueous menstrua. You begin to tremble for the fate of the moth incarcerated in such an impervious dungeon, but without cause; what an *aqueous* solvent cannot effect, an *acid* is competent to, and with a bag of such acid our moth is furnished. The contents of this she pours out as soon as she has forced her head through the skin of the chrysalis, and upon the opposite end of the cocoon. The acid instantly acts upon the gum, loosens the cohesion of the grains of wood, and a very gentle effort suffices to push down what was a minute ago so strong a barrier.

Our attention was called to this subject by a rustling, cutting and tearing noise issuing from a cocoon of *Actias luna*, the large green swallow-tailed silkworm moth. On examination a sharp black point was seen moving to and fro, and then another, until both points had cut a rough irregular slit, through which the shoulders of the moth could be seen vigorously moving from side to side. The hole or slit was made in one or two minutes, and the moth worked its way at once out of the slit. The wings at this time being very small and flabby, and the shoulders being alternately much raised, the points stuck up far enough to cut or saw through the cocoon. The wings were at first of a deep buff yellow, but in half an hour after, the wings began to expand more than before and to turn green. The black points, when the wings are fully expanded, can be detected, not being entirely covered by the hairs at the base of the wing. In this case no fluid was seen to exude from the mouth, and the cocoon was perfectly dry.

On examining two dry denuded specimens of *A. luna*, the black spine was seen at the base of each fore wing, and external to but opposite the end of each patagium. The spine, which may be called the *sector coconis*, is figured by Mr. J. S. Kingsley in the accompanying cut. A represents the specimen of *A. luna* which came out of the cocoon and died with the wings not expanded. It represents a front view of the moth with the shoulders elevated and the rudimentary wings hanging down; *s*, the cocoon-cutter; *p*, patagium. B represents another specimen with fully developed wings; *ms*, scutum; *st*, scutellum of the mesothoracic segment; *s*, the cocoon-cutter, which is evidently a modification of one of the pieces at the base of the fore wings; it is surrounded by membrane, allowing free movement. C and D are different views of the spine considerably magnified, showing the five or six irregular teeth on the cutting edge, the spine being sharp, curved and conical. It will be seen that it acts like a rude saw.



Cocoon cutter of the *Luna* moth.

A number of other members of the sub-family *Attaci* were examined, and this cocoon-cutter was found to be present in all. In *Telea polyphemus* it is large and well developed, though according to Mr. Trouvelot the moth does not apparently need it; still, fresh observations directed to this point may show that it is put to active use. In *Callosamia promethea*, *Platysamia cecropia*, and *P. gloveri* it is rather small. Its use in this latter genus, where the cocoon is left partly open at one end does not seem necessary, still it may come in play while the moth is pushing through the threads which it first encounters. In *Samia cynthia*, and an *Attacus* from Nicaragua, and *Attacus amazonia* Pack. from Pebas, Peru, the cocoon-cutters are rather small, about one-half as large in proportion as in *A. luna*, yet the spines are black. It is large and well marked in the European *Saturnia pavonia-minor* and *Endromis versicolora* Linn.

In *Bombyx mori* the spines are not well marked, and they are quite different from those in the *Attaci*. There are three sharp points, being acute angles of the pieces at the base of the wing. Their relations need examining in alcoholic specimens which we

have not at hand. Still it must be these saws which perform the cutting described by Réaumur. No such spines are present in *Eacles imperialis.*

These observations have been thrown together with the hope of stimulating fresh observations among those raising silkworm moths. Particular attention should be paid to *Telea polyphemus*, in which the cocoon cutter is so well developed, and where its use would seem to be dispensed with, according to the observations of Mr. Trouvelot.

Since the foregoing lines were put in type, I have observed several *Platysamia gloverii* and one *P. columbia* either in the act of making its way out of its cocoon or immediately after. In no case was any cutting or tearing noise heard, though the cocoons were all within a foot and a half of my head, on my study table. I do not believe that the cocoon-cutters, though well developed, are used at all. (In fact, just as I had written the preceding sentence, a male came out of its cocoon, and my attention was first called to it by the rustling it made in creeping over the loose cocoons in the box; no noise was heard previous to its appearance on the outside of the cocoon.)

The inside of the cocoons of *Platysamia cecropia*, *columbia*, and *gloverii*, is glazed to within about a quarter of an inch of the anterior end of the cocoon, beyond it is rough and the silk fibres are capable of being distended and softened by the copious fluid poured out by the moth. The pupa splits along the whole back, sometimes to the end of the abdomen. Before issuing from the cocoon the wings expand much more in *P. gloverii* and *columbia* than in *A. luna;* at least just as the moths work their way out of the cocoon, and before they are entirely extricated, the wings are nearly an inch long. They evidently pull themselves through the aperture by their legs. Previous to extrication they discharge from the mouth a fluid which moistens the silk threads, and also the hairs of the head and thorax, together with the antennæ. This is invariably the case. The insect must with difficulty draw itself through the aperture, which scarcely admits the little finger.

The wings expand fully in from fifteen to forty minutes, usually about thirty minutes, but the moths are not capable of flying for an hour or so after. The moth hangs suspended to some object, with the wings and antennæ drooping down. Though I hatched out several males and females at a time, at different periods, none united sexually, though the females laid eggs.

The cocoon of *P. gloverii* differs from that of *P. cecropia* in being perhaps tougher and paler, more glistening in hue, though of the same form and size. It it always quite distinguishable from that of *P. cecropia.* The cocoon of *P. columbia* only differs from that of *P. gloverii* in its smaller size, and the more distinct patches of silk material scattered on the outside; it is of the same form as in the two other species.

I am indebted to Mr. J. L. Barfoot for a number of cocoons of *P. gloverii*, from near Salt Lake City, Utah, and to Prof. C. H. Fernald and Mr. Anson Allen, of Orono, Maine, for the cocoons and imagoes of *P. columbia.*

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RECENT LITERATURE.

HUXLEY'S MANUAL OF THE ANATOMY OF INVERTEBRATED ANIMALS.[1]—The great advances, within the past ten years, in our knowledge of the anatomy of animals, renders the appearance of this book timely. No one is better fitted than Prof. Huxley to prepare such a manual, which should be authoritative, compact, clearly written, and catholic in its treatment. This book, together with Siebold's Anatomy of the Invertebrates, will form a condensed library for the teacher and student. Prof. Huxley has made a good innovation on the plan of similar books in introducing detailed and more or less illustrated accounts of the anatomy of common types of animals, so that with the aid of this manual the ordinary student can, in a measure, become his own teacher. As a body of well digested facts, clearly and elegantly stated, this book is without a rival.

The classification we should find some fault with, as we do with some of Prof. Huxley's work in this direction, owing, we think, to an inherent lack of perspective in the learned author's mind. For example, the Cœlenterates are described near the beginning of the book, and the Echinoderms near the end; the worms, crustacea, insects, the Polyzoa, Brachiopods and molluscs are then described, and finally we are led to the Echinoderms; the Ascidians coming last, the work closing with the *Peripatidea*, *Myzostomata*, *Enteropneusta*, *Chætognatha*, *Nematoidea*, *Physemaria*, *Acanthocephala* and *Dicyemida.* This arrangement may be in part accounted for by the fact that the book was apparently two years in going through the press, and two years has made a great difference in our knowledge of these last-named groups; but there is no good reason, it seems to us, for separating certain groups so far from those to which they are evidently allied, even

[1] *A Manual of the Anatomy of Invertebrated Animals.* By THOMAS H. HUXLEY. New York. D. Appleton & Co. 12mo. With figures. $2.50.

in a book like this, in which systematic zoölogy is left out of account. The defect is due, we think, to the analytic rather than synthetic turn of mind of its author, and not to the want of adequate knowledge now in the hands of the naturalist.

Few errors of statement will probably be found in this book. We may be allowed to refer to some points to which we should take exception: "Foraminifera," says our author, "are *Monera* of the *Protogenes* type." It is now proved that *Foraminifera* have a nucleus, as stated near the close of this manual, and should be, as they always have been, retained among the *Radiolaria;* why Prof. Huxley should place them among the Monera, which have no nucleus, is a matter of surprise. He regards Eozoön as an incrusting form of Foraminifer, not stating the serious objections that have been made as to its animal nature, and then adopts, as possible, Wyville Thompson's suggestion, that "the enormously thick azoic slaty and other rocks, which constitute the Laurentian and Cambrian formations, may be to a great extent the metamorphosed products of foraminiferal life"!! This really takes our breath away. We leave the matter in the hands of the geologists. Then it is added oracularly, "And there may be no part of the common rocks, which enter into the earth's crust, which has not passed through a living organism at one time or another." Are we not here dealing with a physiology and anatomy not of our earth?

Spongilla is stated to be, among sponges, "the sole fresh-water form." Prof. H. James Clark's *Siphydora echinodes* is said by him to be common in ponds and streams in the United States (Mind in Nature). It is stated that the embryos of *Radiolaria* are "provided with a single flagellum;" in *Collosphæra*, however, there are two. The young Limulus is said, as "Dohrn points out" (1871), to bear a remarkable resemblance to the trilobite *Trinucleus;* this was, however, pointed out by Packard, at some length, with figures both of young *Limulus* and *Trinucleus* nearly a year previous, in this journal for October, 1870. Again, Huxley states, speaking of the metamorphosis of *Atax bonzi*, "The proper vitelline membrane bursts into two halves, much as in *Limulus*, and the deutovum emerges." In *Limulus*, assuredly, the membrane which is referred to as splitting open is the chorion.

The classification of the Arthropoda is essentially artificial, and in it we doubt if the author evinces his usual acumen, certainly a feeble grasp of the subject. The trilobites are associated with the tardigrades and Pentastomida into a division "I. without Gnathites." The trilobites by general analogy are obviously to be associated with the *Merostomata* and Limulus, and, since the publication of this work, Mr. C. D. Walcott has discovered that they possessed "four pairs of manducatory jaws;" and why should *Trilobita* be associated thus with *Tardigrada* and *Pentastomida* when both the latter groups are undoubtedly low Arachnids?

Again, the Arachnida are placed in a division with "pediform Gnathites," but in what respect are the mandibles and maxillæ of spiders and mites any more pediform than those of insects and Myriopods? And in the sucking Myriopods we have an entire family with mouth parts not much higher in grade than those of the Tardigrades and Pentastomida.

The author shows a tendency to coin terms for parts already named, thus *gonapophysis* is used instead of Lacaze Duthier's elegant term *rhabdite* for the blades of the ovipositor. The term *Echinopædium* is used for the larva of Echinoderms, which exactly corresponds to Packard's *Cephalula*, proposed in this journal (May, 1875, p. 283, and Life Histories, p. 94) and extended to embrace a similar phase in molluscs and worms, as well as Echinoderms. But these are the merest blemishes in a work quite indispensible to students, and the production of one whose general accuracy of statement is universally recognized.

Hunt's Chemical and Geological Essays.[1] — No changes appear to have been made in the text beyond the correction of typographical errors, but in the preface to the second edition, Prof. Hunt takes the opportunity to farther notice the question of the temperature of the earth's surface in former geological periods. He concludes that a reduction in the weight of the atmosphere in early geological times, by causes to which he alludes, must have produced a considerable refrigeration of climate, and a still greater cooling of the globe by the diminution of the proportion of carbonic dioxyd contained in the atmosphere. He concludes as follows: "Geographic changes, though a true cause of local variations of climate, and adequate to explain the greater refrigeration of certain areas since the commencement of the pliocene, are not sufficient to account for the warmer climates of previous ages, and we conclude that the cause of these is to be found in the former greater volume and different chemical constitution of the atmosphere, as already set forth.

"This view is opposed to the hypothesis maintained by many geologists of an alternation of warm and glacial climates at the surface of the earth, repeated from the earlier times. Dawson and Heer, however, from the study of the fossil floras found in arctic regions, from the devonian to the miocene, conclude that palæontology affords no evidence of such a condition of things, and the observations of McCoy, Hector and Hutton in the southern hemisphere lead them to similar conclusions. The nurseries of these successive northern floras appears to have been in the arctic regions, and their spread southward would, according to Dawson, be due to continental elevations, bringing about, at irregular periods, a cooler climate in the northern temperate zone.

[1] *Chemical and Geological Essays.* By Thomas Sterry Hunt, LL.D., etc. Second edition. Revised, with additions. Salem, S. E. Cassino, Naturalist's Agency. 1878. 12mo, pp. 489.

It may even be conceived, as well remarked by J. F. Campbell, that such elevations might bring large areas of the earth's surface into the region of perpetual frost, thus giving rise to local glacial phenomena, while a warmer climate prevailed everywhere at the sea level. Nordenskiöld declares that he sought in vain for evidences of ice action in the various sedimentary deposits in Spitzbergen.

"In regard to a suggested explanation of former climatic conditions, the author may be permitted to quote the following language used by him in 1876: 'Recent speculations have revived the old notion of a possible change of the earth's axis of rotation as a way of explaining this change of arctic climate; but such a phenomenon is astronomically improbable, and is also opposed by the fact that the direction of the oceanic currents, which are guided by the earth's rotation, appears, from the distribution of marine sediments to have been the same since very early periods.' Dawson has since urged the same argument, and reinforced it by recalling the fact that the southward migrations of successive floras, not less than the lines of distribution of mechanical sediments in past ages, show that from early palæozoic time the general courses of the oceanic currents, and consequently the position of the earth's axis have not changed."

It seems to us that this is the soundest and best exposition of the question of pre-quarternary glacial climates that we have met with.

The Taconic rocks are further discussed, and the name Taconian suggested for the lower Taconic series. These Taconian rocks are regarded by the author as corresponding to "four great series of pre-Cambrian rocks, and mark as many successive periods in eozoic time." With a reference to recent views on the origin of crystalline rocks, and a re-affirmation of the neptunean views of the author, the preface closes.

Botanical Directory.—The Botanical Directory for America for 1878, will be found exceedingly convenient. Part I gives the names of botanists and their state, while their full addresses will be found in Part II, where the names are arranged by states. The price of this useful directory is forty cents, three copies for one dollar. The list is a large one, and it is only to be desired that a larger portion of those whose names appear were so situated as to be able to be actively engaged as investigators.

Watson's Index to North American Botany.[1]—This is a compact volume compiled and printed with great evident care, and is a laborious and useful work. It is intended to facilitate

[1] *Bibliographical Index to North American Botany; or Citations of Authorities for all the recorded indigenous and naturalized species of the Flora of North America, with a Chronological Arrangement of the Synonomy.* By Sereno Watson. Part I. Polypetalæ. Smithsonian Miscellaneous Collections. 258. Washington, March, 1878. 8vo, pp. 476.

the labors of botanists by furnishing references to all the published descriptions of species of North American plants, with a chronological arrangement of the synonomy. This part covers the ground of Vol. I of Torrey and Gray's Flora of North America. The territory embraced includes Greenland and the Arctic coast on the north, and the borders of Mexico closely adjacent to the United States on the south. The citation of authorities of the species west of the Mississippi and northward is designed to be full and complete, and the same may be said for the Atlantic States before 1840. The work has demanded a good deal of herbarium labor, and will give an undoubted stimulus to botanical studies.

RECENT BOOKS AND PAMPHLETS.—Some microscopical observations of the Phonograph Record. By Persifor Frazer. (Read before the Am. Philos. Society, April 5th, 1877). 8vo, pp. 16.

The Louisville Limestones, &c. By Jas. Hall. (Palæontology of New York, Vol. V, part 2. Advance sheets, Nov. 1877.) 4to, pp. 16.

Studier öfver mjölkdentitionen och tändernas Homologier hos Chiroptera. Af Wilhelm Leche. 4to, pp. 47. Pl. 2. Lund. 1875.

Studien über das Milchgebiss und die Zähnhomologien bei den Chiropteren, von Wilhelm Leche. An abstract of the proceeding in Archiv f. Naturgesch. xxxxiii. Bd. 1. 1877.

Report of Prof. Joseph Henry, Secretary of the Smithsonian Institution, for the year 1877. Washington Gov. Printing Office, 1878. 8vo, pp. 50.

The Geographical distribution of the Mammalia, considered in relation to the principal Ontological regions of the Earth, and the laws that govern the distribution of animal life. By Joel Asaph Allen. Bulletin of the U. S. Geolog. and Geograph. Surv. IV, No. 2. 8vo, pp. 175. Washington, 1878.

On the Janssen Solar Photograph and Optical Studies. By S. P. Langley. 8vo, pp. 5. New Haven, 1878.

A commonly accepted theory in ophthalmic physiology disproved by a crucial experiment. By Henry Hartshorne, M.D. 8vo, pp. 2. (Extracted from the Am. Journ. Med. Sciences, for April, 1878.

Water Supply of the State of New Jersey. Report of a Committee, A. R. Leeds, Chairman. 8vo, pp. 17. Philadelphia, 1878.

On the Asphaltic Coal from the shale of the Huron River, Ohio, containing seams of Sulphate of Baryta. By A. R. Leeds, with a geological note by J. S. Newberry. Read Jan. 11, 1875. 8vo. pp. 2.

Notes on the Locust in the North-west, in 1876. By George Dawson, F. G. S., &c. (From the Canadian Naturalist, Vol. VIII, No. 7.) 8vo, pp. 7. 1878.

On the Mechanical Genesis of Tooth-forms. By Jno. A. Ryder. (Proc. Phil. Acad. Nat. Sci. 1878.) 8vo. pp. 36.

Material for a Bibliography of North American Mammals. By Theodore Gill and Elliott Coues. Appendix B, extracted from the eleventh volume of the final reports of the Government Survey. 4to, pp. 131. Government Printing Office, Washington, 1877.

Original memoirs and clinical lectures. By H. C. Wood, Jr. 8vo, pp. 4. Philadelphia, 1878.

Polarity in character: A study of the sex of mind. By Richard Randolph. 8vo, pp. 20. Philadelphia, 1878.

Recherches sur les fossiles paléozoiques de la Nouvelle-Galles du Sud (Australie); par L.-G. De Koninck, Docteur en Sciences, etc., etc. Text 8vo, pp. 225, accompanied by 4to plates, V–XXIV. Bruxelles, 1876–77.

Palæontological Bulletin, No. 29, Descriptions of Extinct Batrachia and Reptilia from the Permian Formation of Texas. By E. D. Cope. (Published May 8, 1878.)

Ueber Laichen und Entwikelung des Ostsee-Härings. Von Dr. C. Kupffer (aus dem Jahresbericht der Commission zur wissenschaftlichen Untersuchung der deutschen Meere in Kiel). Berlin, 1878. 4° pp.

U. S. Geological Exploration of the Fortieth Parallel, Clarence King, Geologist-in-charge. Vol. 2, Descriptive Geology, by Arnold Hague and S. F. Emmons. Illustrated by 26 plates. Washington, 1877. 4° pp. 890. Vol. 4, Part 1. Palæontology, by F. B. Meek. Part 2, Palæontology, by James Hall and R. P. Whitfield. Part 3, Ornithology, by Robert Ridgway. 24 plates. Washington, 1877. 4° pp. 669.

The Louisville Limestones. Note on the Hydraulic Beds and associated Limestones at the Falls of the Ohio. Palæontology of New York, V. Part 2. Advance sheets. Nov. 1877. 4° pp. 16.

Supplement to the second edition of Acadian Geology, containing additional facts as to the geological structure, fossil remains and mineral resources of Nova Scotia, New Brunswick and Prince Edward Island, by J. W. Dawson, F. R. S., etc. London. MacMillan & Co., 1878. 8° pp. 102.

Sur la Découverte d'un orthoptère coureur de la Famille des Phasmiens dans les Terrains supra-houillers de Commentry. *Protophasma dumasii.* Par M. Charles Brogniart. 8° pp. 4.

The Distribution of the Till in New Hampshire, Massachusetts and Long Island. By Warren Upham. From the third volume of the Final Report upon the Geology of New Hampshire. Concord, N. H. 1877. 8° pp. 24.

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GENERAL NOTES.

BOTANY.

CLEISTOGAMOUS FLOWERS OF DANTHONIA.—I have been much interested in the article in the April number of the NATURALIST, by C. G. Pringle, on the Cleistogamous Flowers of *Danthonia*. *D. spicata* is very common in all our dry, sterile, or rocky woods; occasionally some bunches occur in moist ground, and these can readily be pulled out by the roots, with no disposition to separate at the lower joints; but when the plant grows in dry ground, as it usually does, the culms separate near the root without much difficulty. This I have always considered was due not so much to the plant itself, as to the place of growth; the firm hold the fibrous roots have to the ground, would cause a separation when the plant is pulled vigorously, many others act the same way. With *Danthonia sericea*, however, my experience has been very different from that of Mr. Pringle. This species is quite frequently met with in the dry loose sand in the Pine-barren region of New Jersey, growing in little tufts; in that respect somewhat different in habit from *D. spicata*. Last June whilst botanizing near Egg Harbor City, in this State, I found a large number of these tufts, each having from 6 to 20 culms, and so brittle or readily disarticulating at the lower joints, that it was with great difficulty that I could secure a decent specimen; on endeavoring to pull up the plant, in every instance the separation occurred; the only way to succeed was to dig out the roots without touching the stem at all, and even then the effort to shake off the loose sand, often caused the culm to break away. Our specimens of *D. spicata* very frequently have a few flowers in the axils, but I have never seen any in *D. sericea*.—*Isaac C. Martindale, Camden, N. J.*

MEANS BY WHICH PLANTS ARE PROTECTED FROM ANIMALS AND UNFAVORABLE WEATHER, ETC.—Under this title Otto Kuntze has published a work which has been reviewed in Trimen's *Journal of*

Botany. From animals plants are protected by possession of runners; by close growth (thus effectually banishing animals too large to force a passage); by growing under sheltering bushes (this applies of course to herbs); by twining habits; by epiphytic habits; by presence of spines and thorns (protection against grazing birds); by all forms of trichomes (these, besides hindering browsers, prevent crawling up of insects, &c.); by production of organs and tissues suitable to ant-habitation; by growing in water, and by having leaves adapted to hold water at their bases; by rings of hairs on stems, &c. (against crawling insects); by slippery, waxy surfaces; by milky sap (this, besides being poisonous to grazing animals, by its exudation impedes the movements of small climbing creatures); by presence of ethereal oil in all parts, including the seed (drives away insects); by corky tissues; by possession of leathery leaves which may be distasteful to grazing animals; by development of tubers, bulbs and allied structures; by revolution of leaf margins and of corolla-tips (renders climbing difficult to ants); by the absence of chlorophyll; by poisonous or bitter principles developed chiefly in seeds, these also being protected by their hardness, leathery consistence and small size.

Protections against unfavorable weather are — runners (which support plants against over-weight of snow in alpine and polar regions, and by admitting of a complete covering of snow are enabled to resist the otherwise fatal effects of frost); aëriel roots —props against land-storms and dash of the waves; gregarious habits lessening the force of the winds, a result accomplished also by the horizontal position of the branches, by development of small scaly leaves, and by possession of leafy crowns, deep roots and strong or slim stems; hairy clothing, which protects against cold, rain and undue transpiration, and also intercepts and retains rain and dew; irritability to light or touch; possession of a waxy outer layer and of a strong cuticle; a thick sap which, owing to the hygroscopic property of its solid constituents, keeps the circulation active during the period of greatest sun-heat and dry season; ethereal oils which gradually evaporating, produce resin, a layer of which accumulating on the evaporating surfaces, lessens the amount of transpiration; the thick sap of plants growing in deserts, when the difference between the temperatures of day and night is very great, protects them against injury from the daily great variations of temperature; phyllodes, and leaves occupying the position of phyllodes, being less transpirable, are adaptations to a dry climate; presence of corky tissues which protects against frost, etc., absence of stomata, which in some cases prevents entry of thawing snow; thickened roots, &c., which are stores of nutriment and water, and preserve life during times of drought; besides the many arrangements by which the reproductive organs are protected from rain, dew and wind.

MY HEPATICAS.—One of the interesting things for the botanist or the gardener to do at this time of year, is to remove to some spot in his garden a few of the most attractive wild plants which abound in our woods, swamps and fields. Last year, I removed some plants of blood-root, tooth-wort, spring beauty, phlox, squirrel corn, several species of violets and several *varieties* of hepaticas. These are near the house and are a constant source of delight to the children, visitors, members of the household, and I hardly need add to the person who transplanted the flowers. These were removed as they were found with a little earth about the roots.

Two or three plants of the hepatica were chosen for the pure white of their flowers, others for their delicate pink color, others for the large size of their flowers, others for the deep blue of the flowers; still others were selected for their double flowers. This spring the hepaticas are all true in their peculiarities. One of the blue varieties has already begun to sport. One stem bore two flowers near the top and another three. On a much larger scale I am collecting plants for a wild garden on the bank of a brook and a small pond near the green-house. Here we have a variety of soil from pond to muck or dry sand; from perpetual shade to a full exposure of the bright sun. Here are ferns and grasses, some shrubs and some of the most interesting hardy wild plants. It is a favorite spot for all who live at the College.—*W. J. Beal, Michigan Agricultural College.*

BOTANICAL NOTES.—The Botanical Gazette for April, contains, among other articles, bryological notes by C. H. Austin; new species of Colorado fungi, by C. H. Peck; late Rhode Island flowers, by W. W. Bailey; Coniferæ of the Crestines, by T. S. Brandegee. The bulletin of the Torrey Botanical Club for March contains descriptions of new species of North American *Uredinei*, and an interesting table showing the dates when the leaves fall, by N. L. Britton, who states that "the female in dicœcious plants appears to hold its foliage longer than the male." Caruel's New Botanical Journal (Italy x, No. 2), contains an article on the floral structure and affinities of various monocotyledonous families.

In the *Quarterly Journal of Microscopical Science* are two important papers, one by S. H. Vines, on Researches into the Nature of Lichens, and a very important paper, well illustrated, by J. C. Ewart, on the life history of *Bacillus anthracis*.

ZOÖLOGY.[1]

HELIX CHILHOWEËNSIS Lewis.—I have lately had the pleasure, after a pedestrian excursion of nearly one hundred miles, over the roughest of mountain roads, to collect this rare species in its normal habitat.

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOT COUES, U. S. A.

This shell is held by Mr. Binney, if I mistake not, to rank only as a variety of the *H. diodonta* Say. In this Mr. Binney is following, no doubt, closely in the line of recent zoölogical testimony; but if this species is to be held as a synonym, it will be difficult to convince any fair-minded student of our shells, that, under the same law of interpretation, *H. major* Binney, is not a synonym of *H. albolabris* Say, as held by Mr. Bland; or that *Zonites subplanus* Binney, is other than a variety of *Z. inornatus* Say; or *Z. capnodes* Binney, anything but a variety of *Z. fuliginosus* Griffith. A "general resemblance" in the "jaws" and "linguals" of certain groups, so vague as to render the expression "jaw as usual in the group" sufficiently definite, makes a very convenient post about which to lash the whip of synonyms; but there are other characters, which only the collector can know, that ought, it seems to us, to be taken notice of in all our accounts with authors who have written upon species.

The writer first found the large variety of *H. diodonta* several years ago in Whitley County, Kentucky. He has since collected it in numerous localities of the Carboniferous sandstone region of South-eastern Kentucky and Northern Tennessee, and it has never failed, in a single specimen, to exhibit its normal characters, save in the single particular of size. While shells have been found nearly double the dimensions of Maine specimens received from Mr. Allen, and nearly treble those of New York examples from Dr. Lewis, none have ever been seen, at all approaching, in this particular, the smallest specimens of *H. chilhowëensis*. The latter shell has nearly one whorl more than the *H. diodonta;* it has no tooth on the lower third of the peristome, and at least one-half the specimens which I have collected want the parietal tooth. My largest specimen measures 39 mill. in diameter and 20 mill. in height. There is very little variation in the size of the specimens which I have seen. The animal is slender, quite sluggish in movement, and not timid as is the case with *H. diodonta*. The surface is roughened with irregular, reniform tubercles, the tentacles are very long and delicate, and the foot attenuate and keeled posteriorly.

It has a habit of greatly flattening and spreading its foot, especially after full-feeding, and will in that condition, remain for hours upon smooth surfaces of planed boards, pebbles or lettuce-leaves, evidently in calm enjoyment of its meal, having, in this respect, the exact habit of the European *H. pomatia* L. It inhabits the dense thickets and Kalmia jungles of the Jellicoes, and is rare, even in its native habitat.

The great size of this shell, and that of other species of wider range found with it, offers an argument controverting the prevailing opinion that limestone regions only are favorable to molluscan life.

These shells are found in the carboniferous sandstone mountains

of Tennessee; and among their northern radices or foot-hills in Kentucky, I several years since collected the largest specimens, which I have ever seen, of several common Ohio species. It is fair to remark, however, that the shells are fewer in numbers, both of species and specimens, though so enormously developed in size. Exceptions exist, nevertheless, in both cases. During the present excursion I took specimens of *H. tridentata* Say, measuring 25 mill. in diameter, and specimens of *Z. inornatus* Say, (*subplanus ?*) measuring 23 mill. Associated with these, however, was a variety of the *H. hirsuta* Say, with which all southern collectors are familiar, much dwarfed in size, rounded, and approaching in form the *H. maxillata* Gould. The *H. stenotrema* Fer. from the same locality is very large, and very abundant, as is also the small variety of *H. hirsuta.* Very large specimens of *Z. sculptilis* Bland, were found, measuring 11 mill. in diameter.

Associated with these shells was, also, the very rare *H. wetherbyi* Bland. But one living example of this shell was taken when the species was discovered. To this one Mr. George S. Huntington afterwards added two or three living specimens which he collected in the foot-hills of the Jellicoes. To these the present excursion has added a very few. This species is distributed, so far as traced, through the carboniferous sand hills of southern Kentucky and northern Tennessee, but occurs only rarely, at the foot of cliffs under leaves, or deeply buried under well-rotted logs. The shell is often coated with a mass of sticky dirt, made up of earth and the mucus secreted by the animal, which it is impossible to remove, unless after thorough soaking, without stripping the epidermis from the shell. The animal is blueish-black and finely granulated; the tentacles are very slender and the foot attenuated and sharply keeled behind. This interesting species will probably remain rare in collections, if we may judge fairly, after various endeavors to find it in greater numbers; and the more especially, because a vicious custom prevails in that country of firing the woods every Spring, to consume the leaves fallen from the trees, and encourage a scanty growth of grass upon which the half-starved stock of the idle inhabitants subsists. Only in sheltered nooks that the fire-fiend never reaches, and in the region of springs and mountain brooks are the molluscs safe. But even under these discouraging circumstances, the Jellico range offers a wide field for future discovery. We found here, growing luxuriantly with the *Kalmia*, the beautiful *Lygodium palmatum* Schwartz, the *Epigæa repens* L., the *Gaultheria procumbens* L. and other plants common in more northern mountain regions. Species of rare *Coleoptera* are not uncommon, and no doubt many new species, in all departments of zoölogy, await the explorer who may have the courage and endurance to summer in the foot-hills of the Jellicoes.—*A. G. Wetherby.*

NOTICE OF THE SPIDERS OF THE "POLARIS" EXPEDITION.—The spiders collected by Dr. Bessels during the Arctic Expedition of the "Polaris," are, as might have been expected, very few in number, only *four* species (in *eight* examples) having been brought home. Of these four species two belong to the genus *Erigone*, one to *Lycosa*, and one to *Trochosa;* only one, a small *Erigone*, appears to be new to science, the other *Erigone*, as also the *Lycosa* belong to species that seem to be rather widely spread in the Arctic regions. The *Trochosa* must for the present be left undetermined, the example being undeveloped, and in a very bad state of preservation. All the examples are from West Greenland, and, with exception of the *Lycosa*, which bears the locality: "Foulke Fiord" (at about 78° 20′ lat.), they were all collected at Polaris Bay (about 81° 30′ lat.). The two species of *Erigone*, and probably also the *Trochosa*, are new for Greenland.

In a former paper[1] I have stated that the number of the species of spiders up to that time observed in Greenland, were probably eighteen, described or mentioned partly by O. Fabricius in his Fauna Grœnlandica, and partly by myself. L. Koch[2] has since published a new Greelandian *Lycosa*, *L. aquilonaris;* and Cambridge[3] has lately, besides several other species from the Arctic parts of America, etc., described three new species: *Dictyna borealis*, *Erigone whymperi* and *Linyphia turbatrix* from Greenland,[4] in which part of America, accordingly, twenty-five different species of spiders have hitherto been found. For five of these species, however, only the genera to which they belong have been indicated, for one (*Ar. notata* O. Fabr.) both the genus and the species are uncertain. The number of tolerably well known Greenland spiders is, therefore, as yet only nineteen.[5]

The species of the Polaris Expedition are as follows:

1. *Erigone pschychrophila* Thor.

Syn. 1872. *Erigone psychrophila* Thor., om Arachnider från

[1] Om några Arachnider från Grönland, in Öfvers. af Vet.-Akad. Förhandl., XXIX (1872).

[2] Die zweite deutsche Nordpolarfahrt in den Yahren 1869 und 1870, etc., II Band, Wissenschaftliche Ergebnisse, I Abtheil, p. 400–403.

[3] On some new and little known spiders from the Arctic Regions, in Ann. and Mag. of Nat. Hist. 4 Ser., XX (1877).

[4] *Thanatus formicinus?* Cambr. and *Th. arcticus* Thor. are probably the same species.

[5] These nineteen species are: *Epeira diadema*ta (Clerck), *Tetragnatha Grœnlandica* Thor., *Linyphia turbatrix* Cambr., *Erigone psychrophila* Thor., *E. whymperi* Cambr., *E. penessa* Thor., *E. frigida* id., *E. vaginata* id., *E. spetsbergensis* id., *E. modesta* id., *Steatoda bipunctata* (Linn.), *Dictyna hamifera* Thor., *D. borealis* Cambr., *Thanatus arcticus* Thor., *Lycosa Grœnlandica* id., *L. glacialis* id., *L. aquilonaris* L. Koch, *Trochosa insignita* Thor., and *Epiblemum scenicum* (Clerck). Of these species *Epeira diadema*ta, *Steatoda bipunctata* and *Epiblemum scenicum* are taken upon the authority of *O. Fabricius.* "*Ar. rufipes* Linn." of that author is probably a collective name for several of the above named and other *Erigones;* the true *E. rufipes* (Linn.), Sund. has not, as far as I know, been found in Greenland.

Spetsbergens o. Beeren Eiland, in Öfvers. af Vet.-Akad. Handl., XXVIII (1871), p. 689.

Syn. 1877. *Erigone psychrophila* Cambr., on some new and little known Spid. fr. the Arctic Regions, loc. cit., p. 278, Pl. VIII, Fig. 4.

Of this remarkable spider three full grown males and two females were captured at Polaris Bay, June 3, 1872.

2. *Erigone penessa*, n.—Black, with palpi and legs blackish-yellow, mandibles yellowish, longitudinally striped with black; pars-cephalica elevated, strongly convex transversely, lateral eyes not contiguous, anterior laterals largest of the eight, oval and oblique, area occupied by the middle eyes (of which the anterior are slightly smaller than the posterior, and separated by a very small interval), rather longer than broad, much broader behind than in front; vulva consisting of a shallow transversal fovea, limited behind by a brown shining costa narrowing from the extremities towards the middle, and slightly curved forwards. ♀ *ad.* Length nearly 3 millim.

Female.—Cephalothorax inversely ovate, shining, rather shorter than tibia and patella of the fourth pair, moderately rounded in the sides of the pars thoracica, rather strongly narrowed and slightly sinuated at the pars cephalica; the forehead is rounded, and its breadth equals about two-thirds of the breadth of the pars thoracica; the cephalic furrows are strongly marked; the pars cephalica is elevated and transversely very convex, and provided with several short hairs between the eyes, and a longitudinal row of three longer hairs behind. Seen in profile the back of the cephalothorax rises gradually from the hind margin to the hinder part of the pars cephalica, the back then becoming somewhat sloping forwards, and very slightly convex; a slight depression is seen between the pars cephalica, and the pars thoracica. The front row of eyes is seen from before, nearly straight, but slightly curved upwards; the hind row is curved forwards. The four central eyes occupy an area slightly longer than broad behind, and much broader behind than in front; the lateral eyes of either side are separated by a very distinct interval (not contiguous), and placed on a protuberance. The anterior lateral eyes are the largest of the eight, oval and obliquely posited; the anterior centrals appear to be a little smaller than the posterior eyes; they are prominent, only separated by a very small interval, and their distance from the margin of the clypeus is double as great as their diameter; the interval between them and the anterior lateral eyes is somewhat greater than the diameter of these last named eyes. The intervals between the four posterior eyes, which are very nearly of the same size, are nearly equal, and at least half again as great as the diameter of an eye. Sternum large and broad, convex towards the margins, shining, sparingly spread with fine hairs. Mandibles somewhat ovate, nearly double as thick as the fore

thighs, more than double as long as broad at the base, shining, and somewhat hairy; their back is moderately convex towards the base; their outer side is straight; on the inner, towards the apex, they are gradually narrowing, and slightly rounded; the claw furrow is armed with rather small teeth, the claw is long and slender. Maxillæ rounded on the outer side and at the apex, slightly inclined towards the labium, which is transverse and broadly truncate. Palpi provided with coarse hairs; their tarsal joint is cylindrical and obtuse at the apex. Legs slender, with rather coarse hairs; the thighs are cylindrical (not incrassated at the base above), the tibia of the fourth pair are about four times as long as the patella. Abdomen inversely ovate, shining and covered, though not thickly, with very fine hairs; the vulva consists of a shallow transverse somewhat elliptical fovea near the rima genitalis, the anterior margin of which here forms an elevated rather thick, shining costa, narrowing from the rounded extremities towards the middle, in front, and thus slightly curved forwards, and bordering the fovea behind, and on the sides; the hind part of this costa (or the anterior elevated margin of the rima genitalis), seen from behind, exhibits two small narrow transverse foveæ in front of the larger fovea; the area vulvæ is somewhat striated transversely.

Color.—Cephalathorax, sternum, lip and maxillæ black, the maxillæ a little paler. Mandibles dark yellowish, with three longitudinal black stripes. Palpi and legs of a very dull blackish yellow color. Abdomen grayish black, somewhat olivaceous on the under part; the hairs with which it is covered are olivaceous yellow. The area vulvæ is black, its hind elevated border brown.

Length of body nearly three millim.; length of cephalothorax three-quarters, of abdomen one and five-sixths millim., breadth of abdomen one and one-half millim. Legs I two and two-thirds, II nearly two and one-half, III two and one-quarter, IV nearly three and one-quarter millim.; pat. + tib. IV. nearly one millim.

A single female of this obscure species, which appears to belong to the *E. longipalpis* group, was found at Polaris Bay.

3. *Lycosa glacialis* Thor.

Syn. 1872. *Lycosa glacialis* Thor. Om några Aracln. fr. Grönland, loc. cit., p. 159.
1877. " " *Cambr.*, loc. cit. p. 281.

One adult female example from Foulke fiord.[1]

4. *Trochosa* inc. spec.

A young female of a Lycosoid which belongs, I think, to the genus *Trochosa*, was captured at Polaris Bay. The example is

[1] I take this opportunity to change the names of two North American *Lycosæ*, *L. indagatrix* and *L. imparida*, described in my paper, Descriptions of the Araneæ collected in Colorado in 1875 by A. S. Packard, Jr. (Bull. of the U. S. Geol. and Geograph. Survey, III, No. 2, pp. 512, 513), those names being pre-occupied. For *L. indagatrix* I propose the name *L. dromæa*; for *L. imparida* that of *L. tachypoda*.

very much damaged, most of the legs being reduced to fragments, and the color of the abdomen entirely lost. The foremost row of eyes appears to be slightly longer, or at least is not shorter, than the middle row; the interval between the anterior central eyes is evidently greater than the intervals between them and the anterior laterals, which appear to be slightly smaller than the anterior central eyes. The area occupied by the four posterior eyes is longer than broad in front, but shorter than broad behind; the interval between the two large eyes of the middle row is nearly double as great as their diameter; the interval between the two eyes of the hindmost row equals the length of the middle row. The cephalothorax is brown, its sides covered with coarse appressed, olivaceous-grayish hair; all along the back it has a broad paler band covered with grayish-white hair, which stretches from the middle row of eyes nearly to the hind margin of the cephalothorax, filling up the area between the four posterior eyes, somewhat dilated and rounded in the sides just behind this area, and then tapering gradually backwards. The sternum and the under side of the coxæ are brownish-testaceous, clothed with grayish hair; the mandibles are piceous, covered with coarse grayish hair at the base, black-haired towards the apex. The legs are brown, very distinctly black-ringed, covered with shorter grayish and longer black hairs. Length of the example: seven millim.; length of its cephalothorax three millim.; legs of the fourth pair eight and one-half, patella and tibia of that pair three millim.

By the form of the band along the back of the cephalothorax, as also by several other characteristics, this species would seem to be identical with *Tarentula exasperans* Cambr. (loc. cit., p. 283, Pl. VIII, fig. 7); but in that species the foremost row of eyes is said to be the shortest of the three, whereas in the spider before us the middle row is as short as, if not shorter than, the foremost. —*T. Thorell, Genoa, April* 8, 1878.

THELYPHONUS OFFENSIVELY ODOROUS.—In the *Naturalist*, XI. p. 367, the poisonous nature of the whip-scorpion (*Thelyphonus giganteus*) of Mexico and adjoining portions of the United States was described. That it emits from its "whip" an extremely offensive smell, is stated by Mr. E. Wilkinson, Jr., in a letter to the Smithsonian Institution. The animal was found under stones near Chihuahua. "After considerable difficulty," he writes, "I succeeded in capturing him, but not, however, until I had received several doses of his powerful effluvia, which obliged me each time to retreat and catch a fresh breath."

THE PAPER NAUTILUS IN FLORIDA.—It has been doubted by some naturalists whether the Argonaut, or paper nautilus, occurs on the Florida coast. Two paper shells have been found here this winter, and last winter one was found with the animal entire, besides another empty shell. Its habitat is probably in tropical

seas, but it is sometimes brought to these shores by storms. In the Indian Ocean I have seen it in calm weather sailing on the surface, as described by old writers, but discredited by closet naturalists of these days.—*S. C. C. Halifax Inlet, Florida, Feb.* 17, 1878. *From Forest and Stream, March* 21, 1878.

The *Naturalist*, Vol. XI, p. 243, contains a notice by S. Lockwood, on the occurrence of the paper nautilus on the New Jersey shore.

BUCCINUM UNDATUM *Linné.*—I have received many interesting specimens of this shell from the lobster-men at this town (Stonington Conn). They were brought up from a depth of ten to nineteen fathoms in lobster-pots attached to the "bait." The shells are very fine, with apex absolutely perfect; and in nearly every instance the entire shell is heavily incrusted with *Lithothamnion polymorphum.* I have never before observed this nullipore on shells, though it is common all along this coast on rocks and stones. The incrustation has prevented the erosion of the shell and when removed discloses an almost perfect epidermis. The locality of the *B. undatum* obtained is off Stonington, at the eastern extremity of Fisher's Island, where they occur in considerable numbers. The locomotive powers of *B. undatum* must be quite remarkable, since, in one instance, a lobster-man took between thirty and forty from one pot. These, like *Ilynassa obsoleta*, are seemingly attracted, oftentimes, from a distance, by the bait in the pots.

TRACHYDERMON (LEPTOCHITON) RUBER *Carpenter.*—Four specimens of this species were found on the *B. undatum* taken off Fisher's Island. Its natural habitat is "almost exclusively on and among rocks." Its presence on these shells may serve, in some measure, to explain their distribution. The chiton must go where the shell goes, but at any point may detach itself or be rubbed off and so become "naturalized" at that point. The chitons are on the shell, doubtless, because the nullipore with which it is incrusted forms their natural food. Their color is nearly that of the living *Lithothamnion*, though one specimen is a very dark brown. Their color is, therefore, *protective.—R. Ellsworth Call.*

NESTING HABITS OF THE CANADA FLYCATCHER.—I have submitted the eggs referred to in the "NATURALIST," Vol. XI, p. 565, under the heading—"Red-bellied Nuthatch (Sitta Canadensis)? nesting on the ground," to Dr. Brewer, for examination, and after comparing them with the various similar specimens in his cabinet, he thinks that they should be referred to the "Canada Flycatcher" (*Myiodioctes canadensis*), though even then he would retain the obnoxious interrogation point, as in some respects, the described nest is much unlike the typical nest of this bird.—*Frank H. Nutter.*

Drowned by an Octopus.—Though in British Columbia at the time of the occurence of the incident referred to by Mr. Moseley in Nature (vol. xvii, p. 27), I was in the interior, and consequently heard nothing of the matter. On reading Mr. Moseley's letter, however, I wrote to my friend Dr. W. F. Tolmie, of Victoria, and have just received from him an account verifying in all essential particulars the extract quoted by Mr. Moseley from the *Weekly Oregonian*.

A party of Makaw or Makah Indians, of Cape Flattery, were returning from a visit to the Songish Indians of the vicinity of Victoria, and camped the first afternoon at Metchosin, on the south shore of Vancouver Island. A young woman having separated herself from the others to bathe, did not return in the evening, and after having searched for her in vain the next morning, the rest of the party were about to continue on their journey, when, on rounding the first point, they saw the body of the woman as if seated on the sandy sea-bottom, with a large octopus attached to it, which, according to the description of Dr. Tolmie's informant, resembled a "fifty pound flour sack, full." The body was rescued in the manner described in the *Oregonian*, and when brought ashore, still had portions of the arms of the octopus adhering to it.

Dr. Tolmie also mentions the case of an Indian woman at Fort Simpson, who had, many years ago, a narrow escape from a similar death; also that among the Chimsgau Indians traditions of escapes and occasional cases of drowning exist, and further, that among these people a story is current that "a two-masted vessel manned in part or whole by men, with obliquely placed eyes and wearing queues (at Milbank Sound, Lat 52°, about seventy years ago), was seized by an enormous squid, whose tentacles had to be chopped with axes ere the craft was clear of it. The ship is said to have been wrecked further south on the coast, in consequence of the evil influence of the monster."—George M. Dawson, in *Nature*.

The Habits of the Muskrat.—About the middle of last November while walking along the banks of the North Fork of Sappa creek, Rawlins county, Kansas, my attention was directed to an old beaver dam that had been recently repaired by a muskrat. Mud had been placed on the dam so as to make it watertight, but so far as I could see no sticks had been brought there, excepting those used in the first building by the beaver. Some of the mud was removed so as to allow more water to escape and a trap set. The next morning the trap was sprung and the mud partly replaced. No beaver signs were to be found anywhere, while the tracks of muskrats were numerous in the mud used in repairing, and elsewhere around the dam. A trapper informed me that he had frequently observed dams that had been repaired by muskrats in a simlar manner.—*Russell Hill.*

IDENTITY OF DIEMYCTYLUS MINIATUS WITH DIEMYCTYLUS VIRIDESCENS.—Last summer I brought home from Sullivan county, Penna., a large number of specimens of *Diemyctylus miniatus* Raf., popularly called "little red lizard" or "red eft," and after keeping them in a dark box filled with moss, saturated with water, all the specimens have changed their color from bright vermilion to the olive shade characteristic of *D. viridescens*, and are in all particulars identical with the last named species. Although the specimens were kept in a moist medium, they were at no time immersed, and to make the test crucial I dropped three of them into a tub inclined at an angle with the floor and partially filled. Upon their immersion they immediately swam or wriggled vigorously for land, but after leaving the water and stopping a few seconds they turned around and walked back into the water and remained there, only coming up at intervals for air. One remained thus fifteen minutes before rising to the surface. Some hours after, upon watching them again, it was twenty minutes before one of them returned to the surface, and as the others seemed disposed to remain under a much longer time I was obliged to leave them. These specimens have been kept in the house all winter and are almost as lively as those I watched at the bottom of the lake in the summer. This morning I agitated the water with the tips of my fingers, and, upon attracting their attention, saw two of them gulp down two pieces of raw meat. Nothing could more satisfactorily demonstrate their entire satisfaction with the element in which they had been newly placed. The conclusion then is that instead of two well marked species, *D. viridescens* and *D. miniatus*, or of a species and a variety, we have but a single species *Diemyctylus miniatus*.

Dr. Hallowell was the first to express his belief that these so-called distinct species were the same (Proc. Acad. Nat. Sci. Phila., Feb. 1856). This was followed in April, 1859 (Proc. Acad. Nat. Sci. Phila)., by the statement made by Prof. Cope, after detailing the synonyms of *D. viridescens*, "We include in the above synonyms those of the nominal species *D. miniatus*, which we think with Dr. Hallowell is a state of *D. viridescens*." In the Proc. Boston Soc. Nat. Hist., Prof. Verrill's remarks, respecting *D. miniatus*, "I cannot agree with Prof. Cope in regarding this as a form of *D. viridescens*."—*Howard A. Kelly.*

AN EARLY BIRD INDEED.—On March 21st I was shown a chipping sparrow's nest (*Spizella socialis*) in the midst of a strawberry bed on the farm of Mr. John P. Sanborn, near the city of Port Huron, Michigan, in which were three newly-hatched little ones and an egg. Such an occurrence, *even in the middle of April*, is unprecedented in this latitude. Robins appeared February 11th, bluebirds February 18th, blackbirds, song sparrows and golden-winged wood-peckers observed February 22d, bob-o-links March 2d, martins March 3d.—*G. A. Stockwell, M.D., Port Huron, Mich.*

ANTHROPOLOGY.[1]

LANGUAGE MAP OF AMERICA.—In the *Geographical Magazine* for March, 1878, the statement is made that Mr. A. H. Keane is collecting materials for a language map of America. We cannot speak from personal experience concerning the difficulties of such an undertaking for South America; but we can assure any one who attempts the task for North America that the impediments are almost insurmountable. The Smithsonian Institution has for twenty-five years zealously collected vocabularies and other linguistic material. These have all been placed in the hands of Major J. W. Powell, who has called to his aid most of the eminent philologists of our country in adding to and perfecting what has been already gathered. The first volume of "Contributions to American Ethnology," already published, is the harbinger of a series which, when completed, will exhibit the linguistic geography of our aborigines. Dr. Berendt is doing similar work for Middle America.

THE DAVENPORT TABLET.—With respect to the Davenport tablet, concerning which a mild caution was ventured in the May NATURALIST, Mr. J. Duncan Putnam, corresponding secretary of the Davenport Academy, writes: "This tablet was found by Mr. Gass, and is believed to be just as genuine as those found a year ago, and they appear to be just as genuine as the copper axes, stone pipes, sea shells, etc., found along side of them. They may be all "got up," but if so the evidence is very strong that they were not done by any "wag" of the present generation. A full account of this last find will be printed in our next number of *Proceedings*, now in press."

ANTHROPOLOGICAL NEWS.—The Rev. Stephen Bowers is lecturing in the western cities upon Explorations in Southern California. The labors of Mr. Bowers were confined to that portion of the state bordering on the ocean, and to the Santa Barbara islands. His contributions to the National Museum equal in value and number those of any of its numerous friends.

MR. J. D. McGUIRE, of Ellicott city, Maryland, in a letter to the Smithsonian Institution, speaks of a number of arrow-heads in his possession whose points have been polished apparently by design. As this is the first allusion to the subject of polished quartz arrow-points, the discovery of Mr. McGuire is very interesting. If the same phenomenon has been observed elsewhere we should be glad to know it.

THE Annual Report of the secretary of the Smithsonian Institution contains a detailed account of a forthcoming publication from the pen of Dr. Habel concerning the discovery of sculptured slabs at Santa Lucia Cotzumalhuapa, near the city of Gua-

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

temala. Several years ago Dr. Habel resigned a lucrative medical practice in New York to visit Central America. While in Guatemala he came upon these interesting remains which he cleared away at great expense of time and labor, and the sculptures of which he copied with the greatest accuracy. These slabs resemble the best sculptures of Mexico and Central America in the objects represented, and in the barbaric exhuberance of ornament. There are two features which are almost unique, the symbol for speech, and for numerals. The speech symbol consists of a vine-like ridge proceeding from the mouth or neck of the suppliant or of the divinity and winding about in various shapes. The staff or ridge is adorned with nodes and trefoils in such positions and groups as to give great plausibility to Dr. Habel's belief that the ornamented staff indicates the very desire or thought of the speaker. The numeral symbol consists of rows of rings accompanied by parallel and cross lines. The beauty and uniqueness of these sculptures will make Dr. Habel's paper one of great interest and value. The slabs were purchased, subsequently to Dr. Habel's visit, by Dr. Bastian, and will be removed to Berlin.

THE *Archiv für Anthropologie*, part 4, for 1877, is one of the most valuable numbers of that periodical which have appeared. In addition to the usual amount of original matter, an account of which will be found below, a series of papers is commenced entitled, "Die anthropologischen Sammlungen Deutschlands: ein Verzeichniss des in Deutschland vorhandenen anthropologischen Materials nach Beschluss der deutschen anthropologischen Gesellschaft zusammengestellt unter Leitung des Vorsitzenden der zu diesem Zwecke ernannten Commission." The first paper of 68 pages is devoted to the anthropological collection of the anatomical museum of the University of Bonn, and contains the description of 446 human and simian skeletons and skulls. The papers are so arranged that they can be detached from the *Archiv* and subsequently bound in a separate volume. It makes one sigh for the spirit of Jeffries Wyman to think how little the anatomists of our country are doing with the rich material scattered on every hand.

THE following papers have come under our notice: Der Nachfolger des Onondaga-Riesen, C. Rau, *Archiv*, vol. x, No. 4; Prehistoric Ruins in Dade Co., Missouri, *Western Review*, April; The Blackwater, Missouri, Mounds, *id.*; Soapstone Quarry in Providence county, R. I., *id.*; L'ancienneté de l'homme au Mexique, *La Nature*, March 23d; Brandsford's Ausgrabungen auf Ometepec, *Globus*, xxxi, No 21; Die Mineralogie als Hülfswissenchaft für Archäologie, Ethnographie, u. s. w., mit specialler Berücksichtigung. mexicanischer Sculpturen, II, H. Fischer, *Archiv*, x, 4; Lebensweise und Geräthe der süd-chilenischen Indianer, *Correspondenzblatt*, 1878, I.

Foreign papers of general interest are: Finländische Archäologische Literatur von 1745 bis heute, Dr. J. R. Aspelin in Helsingfors, *Archiv*, x, 4; Mittheilungen aus der Anthroplogischen Literatur Belgiens im Jahre 1876, Prof. L. von der Kindere, Brüssel, *id.*; Mittheilungen der russischen Literatur über Anthropologie, Dr. Ludwig Stieda, *id.*; Archæological Researches at Carnac, in Brittany, James Miln (David Douglas, Edinburgh); Ueber die achte Jahresversammlung der deutschen anthropologischen Gesellschaft, Graf Wurmbrand, *Mittheilungen* der Anthropologischen Gesellschaft in Wien, 1877, 10; Ueber neue Ausgrabungen auf den alten Gräberstätten bei Hallstatt, Dr. Ferd. von Hochstetter, *id.* 11; Zur Ethnographie Noricums, Dr. Fligier, *id.* 10 (a very scholarly paper made more valuable by the abundance of references to authorities); Die Ethnographie der Balkan-Halbinsel im 14 und 15 Jahrhundert, Prof. G. Hertzburg, Petermann's *Mittheilungen*, 1878, iv; Die Anfänge des Staats-und Rechtslebens, *Das Ausland*, April 1st; Growth of Ideas and Customs, E. B. Tylor, a lecture before the London Institution April 11th; Die Urgeschichte der Menschheit, Otto Caspari, 2d edition, Leipzig; On the Human Hair, Prof. Schwalbe, *Correspondenzblatt*, 1877, 2; On the Influence of Climate upon the Development of Art, especially Architecture, Prof. Portlage, *id.*

Indian Food Customs.—When an Indian is out of food he goes to those who have plenty, and it is considered a breach of etiquette not to feed the hungry. The provident are often imposed upon in this way. The Indians think it very strange that some whites have a superabundance of food while others have none at all. The females provide most of the food. They are the gatherers of nuts, seeds, roots and fruits, and convert them into bread and mush, while the men provide the meat. The labor of collecting these vegetable products is very great, the women being compelled to wander miles from their homes to obtain them. They are often seen on their homeward march with astonishing loads, so bulky at times as to conceal them entirely. They wander about all day in the grain fields picking up head by head until they have secured a load. A merchant of Tucson informed me that he had bought from some Papago women three sacks of wheat secured in this manner. The Indians formerly made two kinds of bread, one is a small flat cake or biscuit baked in the ashes, the other is as thin as a wafer, and made in the following manner. Meal or flour from any native product is mixed with water and a little salt to the consistency of dough. The cook then takes a piece in her hand, pulls it and flattens it out until a large, thin, round cake is formed. This is baked on a flat, hot stone, first on one side and then on the other. Much of their flour and meal is eaten as mush or gruel, which they relish very much.—*Edward Palmer.*

FISH-HOOKS OF THE MOHAVE INDIANS.—Questioning some old Indians about their native fish-hooks, I found that they used the spine of a cactus for this purpose. Having made a bargain with one to allow me to see him make the hooks, he returned in a few hours with a plant and a number of the spines of *Echinocactus wislizeni*. He commenced by placing the spines in water for a short time in order to render them pliable, at the same time wrapping the thumb and first finger of his right hand with rags. He then made a small torch about half the size of one's little finger by twisting some pieces of rags together rather tightly. Selecting a spine from the water and placing it between the ends of the wrapped thumb and finger, the torch was lit and held in the left hand close to the spine, the workman dexterously changing the position so as to impart the same amount of heat to all portions at once. Occasionally he moistened the spine in his mouth. By this application of heat and moisture he tempered the spine, and at the same time applying a gentle pressure by the end of the wrapped finger he was soon able to produce a very fair and strong hook. As soon as a sufficient curvature is obtained, it is secured by fastening a string from the point to the shaft.

The fish of the Colorado river, eaten by the Mohaves, do not nibble the bait, but bolt it, hook and all, and are killed by the wounds which are made in their gills. This cactus-spine hook would be of no use in catching fish that nibble, as there is no barb. The Indians fasten the bait below the hook, before throwing it into the water. The iron hooks obtained from the whites now take the place of their old-fashioned ones.—*Edward Palmer.*

INDIAN STEATITE DISHES.—A very interesting discovery has recently been made by Mr. H. N. Angell, of Providence, R. I., showing how the Indians formerly manufactured steatite dishes. As he was quarrying about a ledge of rocks near his home, early in the month of February, he came upon a bed of soapstone, which bore evident traces of having at one time been artificially worked. Cart loads of steatite dust and chippings were removed before the ledge could be uncovered, when it presented a very peculiar appearance, being covered by protuberances and depressions. A number of finished vessels were obtained and many more in a partial state of completion. The pots were first rudely carved out of the rock with slate or stone knives and chisels, bottom-side up, and were then removed from the mass by inserting wedges beneath them; after which they were hollowed out. Mr. Angell states that "the soap-stone bed, as now uncovered, is about 30 by 90 feet in extent, and all of the surface has been worked. We found by excavating in other places in the vicinity, stone hammers, chisels and sledges that will weigh from 50 to 150 pounds. We also found a rudely wrought stone which resembles a plough and which will weigh over 100 pounds." The

bed of steatite had been lowered several feet by the removal of the stone, and it is certain that great numbers of vessels were fashioned at this quarry.—*E. A. Barber.*

Surgeon John H. Janeway has presented to the Army Medical Museum five crania from the shell-heaps near St. Augustine, Florida. These crania are especially remarkable for the position, shape and size of the foramen magnum, and for the great size of the basilar process, occasioned by the extremely backward position of the foramen magnum. The museum has also received from Second Lieutenant C. A. H. McCauley a cranium from the ruins of Mesa Morasis, on the Rio de los Animos, near its mouth. This is the fourth cranium from these cliff structures, furnishing a good beginning for a comparative study. It is to be hoped that this splendid collection, now under the charge of Dr. Otis, will be fostered by anthropologists in all parts of our country. The Quartermaster's Department have orders to transmit all specimens to Washington, free of charge.

Mr. Spofford, of the Congressional Library, is now publishing a complete catalogue in one alphabet of everything in the library, with titles complete, including the Smithsonian additions, under the names of societies.

In the *Magazine of American History* for February, Dr. Charles Rau publishes the paper on the Dighton Rock Inscription which he read before the American Anthropological Society last September.

Mr. E. A. Barber communicates the fact that in the "Museum of the Pennsylvania School of Industrial Art," in the Memorial Hall, Philadelphia, is a collection of relics from the Swiss LakeDwellings. We shall be glad to publish the location and special character of public and private collections of merit in our country.

The following works and papers have appeared: Mound Explorations in South-eastern Missouri (in Madrid county), by C. Crosswell, Trans. of the Acad. of Sciences of St. Louis, Vol. iii, No. 4; Antiquity of Caverns and Cavern Life in the Ohio valley, by Prof. N. S. Shaler, Boston Soc. of Nat. History; Les Esquimaux (based on the presence of a group of them in the Jardin d'Acclimation de Paris), *Révue Scientifique*, Jan. 26th; Colored People considered scientifically and socially, by D. H. Jacques, *Phrenological Journal*, Dec.; The Southern Negro as he is, by George R. Stetson (A. Williams & Co.); Cuban Antiquities: the Caneys of the Dead, by Antonio Bachiller, *Magazine of American History*, Dec.; The Second Conquest of Peru, by C. P. Mackie, *Penn Monthly*, Feb.; Pottery: How it is Made, by George Ward Nichols (G. P. Putnam's Sons); A Hand-book of Ceramic Art, by M. S. Lockwood (*id.*); Bibliotheca Americana, by Robert Clarke & Co., Cincinnati.

FOREIGN.—An interesting course of lectures has been inaugurated in connection with the new museum of ethnography at Paris.

Nearly every afternoon is appropriated to a discourse by some eminent savant on topics illustrated by the collections in the museum.

The German Emperor has presented to the ethnographical department of the Royal Museum at Berlin, a collection of weapons from Java, Sumatra, Borneo, Celebes, Flores, Amboyna and other islands, made by Herr Erdmann, German Consul at Samarang, Java.

On Friday, February 15th, the Rev. W. E. Cousins read a paper before the London Philological Society on Malagasy, the language of Madagascar, a short sketch is given in *The Academy* for March 2d.

Dr. Stuart Eldridge sends a copy of his pamphlet on the crania of the Botans of Formosa, read before the Asiatic Society of Japan, March 14th, 1877. The first few pages are occupied with a résumé of the science of craniology. The researches of Dr. Eldridge were made on four skulls. The Botans, or Motans, are one of the aboriginal tribes of Formosa, having a fine physical development, and distinguished by the following characteristics: They are courageous, frank and impressible; straight haired; complexion varied, but always of a brown tint, never black; having some knowledge of agriculture, cultivating tobacco, root-crops and rice; domesticating buffaloes, pigs, dogs and poultry; living under a patriarchal organization; fond of the chase; having some slight knowledge of certain arts, and a rude form of religion, the cultus of which is, at least to some extent, in the hands of priestesses who are highly reverenced. There are no signs of artificial distortion in any of the skulls; when held at arm's length the malar bones are visible on either side, and all are dolichocephalic. In all, the upper edges of the zygomata are somewhat convex, the temporal ridges are strongly marked, the processes are highly developed, the mastoids are about the average, the external auditory foramina are oval, the arch of the palate is low and flat, the external opening of the nose is large, the frontal sinuses are small, and the ethmoidal ridge of the frontal large and prominent. They are almost uniformly orthognathous. The orbits in Nos. 1 and 3 are somewhat square in outline, while in No. 2 the orbit is elliptical, the axis being directed downward and outward. The occipital foramina of Nos. 1 and 4 are rather more oval than common, those of Nos. 2 and 3 being about normal in shape. The sutures of Nos. 1, 2 and 4 are distinct and ununited. In No. 3 all the sutures save the squamous and a part of the lambdoidal are obliterated. The pamphlet closes with a tabular view of the measurements of the skulls according to the scheme of Huxley, from which a few are extracted: Length 7, 6.95, 7.15, 7.02 inches for the four skulls respectively; breadth 5.45, 5.35, 5.38, 5.28; height 5.30, 5.27, 5.52, 5.26; cephalic index .78, .77, .75, .75; facial angle 76.3°, 80.5°, 84.3°; capacity 84.82, 91.34, 83.43, 75.90 cubic inches.

GEOLOGY AND PALÆONTOLOGY.

A NEW OPISTHOCŒLOUS DINOSAUR.—I have recently received from the Dakota beds of Canyon city, Colorado, a number of bones of a new and remarkable extinct reptile allied to *Camarasaurus* (= *Titanosaurus* and *Atlantosaurus* Marsh nom. nud.), and *Streptospondylus*. The dorsal vertebræ are strongly opisthocœlous, and are without lateral fossa or foramen of the centrum. The arch is freely articulated with the latter, and is not much elevated, and possesses no hyposphen. The neural spine is transverse; the diapophysis is supported on narrow buttresses, and the neural arches generally lightened by fossæ as in the two genera named. A strong parapophysial tubercle near the anterior convexity receives the head of the rib. Each zygapophysis of one side is separated from that of the other by a deep concavity. The genus so characterized may be called *Epanterias*. and the species *E. amplexus*. The latter has a rather low and wide dorsal neural arch with small fore and aft diameter, and with a neural spine divided into three obtuse apices. There are three fossæ at the base of the diapophysis, the anterior one vertical; and a very deep one between the posterior zygapophyses. The cup of the centrum embraces the ball extensively, and the neurapophysis overlaps the side of the centrum behind. Length of centrum m. .115; diameters behind, transverse, .120; vertical .108. Elevation of neural arch .290; width of neural spine .083, of both diapophyses .400. This saurian was much smaller than the *Camarasaurus supremus*, and perhaps equal to the *Hadrosaurus foulkei*. It may be associated with the former in the *Camarasauridæ*. With *Amphicælias* is probably in like manner to be arranged *Tichosteus;* while the carnivorous form *Hypsirhophus* represents a third type.—*E. D. Cope.*

PROF. MARSH ON PERMIAN REPTILES.—In the May number of the *American Journal of Science and Arts*, there is an appendix added by Prof. O. C. Marsh, in which he characterizes in a very insufficient manner, four species of reptiles, which he states to have been derived from a Permian formation in New Mexico. We should not regard this article as suitable for notice in this journal but for certain assertions which it contains, and some circumstances connected with its publication. In the opening paragraph it is asserted that "hitherto no Permian vertebrates have been identified in this country, although not uncommon in Europe." This statement is the reverse of the fact. In the Proceedings of the Philadelphia Academy for 1875, p. 404, a paper on this type of vertebrates commences, where some of the leading characters of the reptiles are pointed out. In the Proceedings of the American Philosophical Society for May, 1877, several new species are described from the same formation, and in the same journal for November, 1877, other species are added, making the whole number up to twenty-one. These

papers Prof. Marsh has had the opportunity of seeing. Two further notices of the vertebrates of the American Permian appeared on April 22d of the present year, in the May number of this journal, pp. 319, 327. As the corresponding number of the *Amer. Jour. Sci. and Arts* was not issued before May 5th (perhaps a day or two sooner), Prof. Marsh had the opportunity of seeing these also. They include references to seven new genera, for most of which the characters are clearly pointed out.

The features common to the genera of the Permian, described by Marsh, are stated by him to be those characteristic of the order *Rhynchocephalia*; as I have already shown to be the case with the forms described by me in the earliest as well as later papers of those cited. Another characteristic is said to be the presence of the intercentrum, a statement agreeing with my own in the May number of this journal. It is also observed that there is a double tubercular rib-articulation of the centra, a structure I have already described in the genus *Diplocaulus*.[1] Prof. Marsh's statement that the mode of implantation of the teeth is similar to that of the "*Mosasuria*" is probably incorrect.

As the author of the paper does not think it necessary to allude to published sources of information, it is too much to expect him to give credit for ideas communicated to him verbally. *All* of the above mentioned, and additional characters cited by Marsh in his two opening paragraphs[2] (l. c. 409) as belonging to the Permian Reptiles, with others, were explained by me before the National Academy of Sciences, with Prof. Marsh as an attentive listener, at its last meeting in Washington, April 18th, more than two weeks before the appearance of the paper here criticized. The characters to which I refer are "the separate pre-maxillaries, the immovable quadrate, and the biconcave vertebræ;" the "hypaxial elements of the vertebræ called by [von Meyer] intercentral bones." "These intercentral ossifications apparently exist in all the Reptilia yet found in this new fauna." Compare these statements with those found in my paper read before the National Academy (which had been previously read before the American Philos. Society, April 5th) and published May 8th. That Prof. Marsh profited by what he heard, is evidenced by his use of the term "intercentra," first introduced by myself. From this point of view it is easy to understand his attempt to make it appear that Meyer first used the word. He says, "Another character of much interest is the presence of certain hypaxial elements of the vertebræ, first observed by von Meyer in the Triassic genus *Sphenosaurus*,[3] and called by him intercentral bones ('*Zwichenwirbelbein*')" (sic). As *Zwischenwirbelbein* does not mean intercentrum, but *interver-*

[1] Proceed. Amer. Philos. Soc. 1877, p. 187.

[2] Except that mentioned previously under *Diplocaulus*.

[3] Which I referred to the *Rhynchocephalia* in 1870; see Proceed. Am. Ass. Adv. Sci. xix, p. 242.

tebral bone, Prof. Marsh's knowledge of the former term must be ascribed to some other source. The fact that the Amer. Journ. Sci. Arts appeared a good deal later than its usual date of publication, may be considered in this connection.—*E. D. Cope.*

Fossorial Reptiles.—Prof. Cope has recently described some reptiles from the Permian formation in which the humeri possess many of the characters of those of the mole and other fossorial *Mammalia* in the great development of the muscular insertions and epicondyles, and the presence of a supracondylar foramen. They are referred to five species of three genera of *Pelycosauria*, a tribe of the order *Rhynchocephalia.*

GEOGRAPHY AND TRAVELS.

Richthofen's China.[1]—The portion of this great work relating to the loess, so wonderfully developed in parts of China, was noticed, at some length, by Prof. Whitney in the December number of this journal. We will merely run through the table of contents, to show the breadth of the researches made by the learned author, so well known in this country for his investigations in the geology of California. The general features of China and Central Asia, the loess formation in Northern China, the structure and formation of the salt steppes of Central Asia are discussed at length. This portion is followed by chapters on the transition region of Central Asia, on the distribution of desert and loess-covered regions in other parts of the earth; the plateaux of Central Asia, embracing the Tiën-shan, Kwen-lun and the mountainous regions in Southern Asia. The second part relates to the development of our geographical and historical knowledge of China. The wood-cuts are in many cases full-page illustrations and, with the maps and general elegance of the typography and paper, in addition to the text, render the work of a high order of interest.

The Big Horn Cañon.—Gen. Brisbin has given an interesting account of the Powder river country, extending from the sources of the Big Horn and Powder rivers over the Big Horn mountains and the plains as far as the Missouri river, a country unknown to white men until 1866. "It contains," says Judge Daly in his recent address to the American Geographical Society, "one of the greatest natural curiosities of our continent, the Big Horn Cañon, which rivals the famous gorge of the Colorado."

The Isthmus of Darien.—A valuable map and notice of recent surveys, especially those of Lieut. L. N. B. Wyse in 1876

[1] *China. Ergebnisse eigener Reisen, und darauf gegründeter Studien.* Von F. T. von Richthofen. Eister Band. Einleitender Thiel. Mit 29 wood-cuts and 11 maps. Berlin. D. Reimer. 1877. 4to, pp. 758.

and '77, appears in the *Geographical Magazine* for April. Lieut. Wyse reports that a canal directly up the valleys of the Jupisa and Jiati is feasible, and recommends this route. He pays a just tribute to the work done by his predecessors, Commanders Selfridge and Lull, of the U. S. Navy. Farther explorations were carried on the past winter by Lieut. Wyse.

GEOGRAPHICAL NOTES.—The *Geographical Magazine* for April contains a colored map, giving the proposed changes in the territorial boundary of European Turkey, as stated in Articles I, III and VI of the preliminary treaty of peace. Mr. J. Boyer has lately ascended Mount Ararat, which is 17,000 feet high. Large beds of snow extend down to a height of 11,000 or 12,000 feet. The last part of the ascent was upon a slope of rotten rock, which crumbled under foot, making the ascent very fatiguing. He found not a fragment of Noah's Ark.

MICROSCOPY.[1]

A NOVEL STAND.—A microscope stand, recently made for Dr. Blackham, of Dunkirk, by Mr. Tolles, of Boston, combines with the usual excellencies of that maker's work, some peculiarities designed to fit it especially for optical experiments. The stand is made on the Jackson model, and the slide behind the body, by which focal adjustment is made, is furnished with a scale and vernier by which the working focal distance of the objectives used can be measured with facility. Dr. Blackham claims this device as his own, though the claim has brought to light representations that the device has been previously used or suggested by Mr. Geo. E. Fell, of Buffalo. The most conspicuous peculiarity of the instrument is the method of mounting the mirror and sub-stage. Back of the stage and between it and the curved arm that supports the body, is a brass disc three-tenths of an inch thick and nearly five inches in diameter. This disc is arranged vertically between the body and the curved arm, with its center in the horizontal plane of the object. On the face of this plate, and near to its circumference, is a deep circular groove in which slides a radial arm which bears the sub-stage, mirror, etc. This gives, with great smoothness, the rotation of all the sub-stage apparatus around the object on the stage as a center. Though made last year, Mr. Tolles claims that this expedient was designed by him in 1871, thus anticipating the introduction of similar devices by other inventors during the last few years.

MICROSCOPICAL SOIRÉE.—The State Microscopical Society of Illinois held its annual soirée, by invitation, at the residence of Mr. E. W. Blatchford, at Chicago, on the 8th of March. This *conversazione* was one of the most notable scientific events that have ever occurred in the city. Though given in the name of the

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

State Society, the invitations were not limited to its members, the spacious residence being so thronged during the evening that fully 700 people are believed to have participated in the reception. Among the guests were many of the leading citizens of the town. Over fifty microscopes were in use, on tables distributed through a number of rooms, the whole house being given up to the entertainment. The arrangements were under the direction of Messrs. Henry W. Fuller, president, H. F. Atwood, secretary, and B. W. Thomas, treasurer of the society, assisted by Prof. S. H. Peabody, of the Academy of Sciences. A well-selected variety of popular objects was shown by members of the society, including some that are seldom used at public exhibitions on account of their difficulty—Mr. B. W. Thomas showing under two binoculars the circulation in both the tongue and the lungs of the frog. In addition to the instruments owned in the city, a variety of Beck and of Gundlach microscopes were loaned to the society by Messrs. Walmsley and Bausch & Lomb. Variety was contributed to the entertainment by experiments with electricity and the telephone. Both socially and scientifically the reception was most creditable and encouraging to the society.

MICROSCOPICAL SOCIETY ELECTIONS.—The biological section of the Indianapolis Lyceum of Natural History was organized Feb. 28, 1878, the first officers being Henry Jameson, M.D., president, and W. Webster Butterfield, M.D., secretary. Meetings occur on the first Tuesday evening of each month.

The State Microscopical Society of Illinois, at its annual meeting held April 26th, elected the following officers: President, Henry W. Fuller; vice-presidents, Harvey M. Thompson and H. F. Atwood; secretary, Prof. S. H. Peabody; corresponding secretary, James Colgrove; treasurer, B. W. Thomas; trustees, Prof. E. S. Bastin, Dr. Lester Curtis, E. W. Blatchford, Samuel J. Jones and W. H. Summers.

At the annual meeting of the American Microscopical Society of the city of New York, held Tuesday evening March 26, 1878, the following officers were elected for the ensuing year: President, John B. Rich, M.D.; vice-president, Wm. H. Atkinson, M.D.; secretary, O. G. Mason, Bellevue Hospital; treasurer, T. d'Oremieulx; curator, John Frey.

MICROSCOPICAL CONGRESS.—The invitation to the Microscopical Congress at Indianapolis, next August, has been accepted by a number of societies as well as prominent workers with the microscope, and the meeting promises to be large, and most interesting to those who participate. Particulars in regard to the arrangements will be ready shortly, and can be obtained, in form of a circular, by addressing Dr. W. W. Butterfield, Indianapolis, Indiana.

ERNST GUNDLACH.—This well-known optician, who has been with the Bausch & Lomb Opt. Co., during the past two years,

announces his withdrawal from that company and his establishment of a factory in Rochester, in his own name, devoted entirely to microscopical work. He offers stands, with all his former improvements and with some minor advantages now added, and objectives of increased angle and reduced price. His higher powers will be on the four-system plan, and claim the excessive aperture of 150 degrees in water.

EXCHANGES.—Isthmia nervosa, rich specimens *in situ* on algæ, in exchange for any good mounted objects. M. A. Booth, Longmeadow, Mass.

Leaves with very beautiful stellate hairs and also a variety of marine objects, from the Bahamas, in exchange for mounted or unmounted objects. C. C. Merriman, Rochester, N. Y.

WANTED—Some well posted diatomist to give the names of diatoms, arranged, on a few slides, in exchange for the slides. C. M. Vorce, Cleveland, Ohio.

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SCIENTIFIC NEWS.

— Science in America has met with an irreparable loss in the death of the honored and revered Prof. Joseph Henry, secretary of the Smithsonian Institution since 1846, and president of the National Academy of Sciences. He was born in Albany, N. Y., December 17, 1797, and died May 13, working at his post, engaged, until a few days before his death, in arduous and responsible duties. We have but space, at this time, to record briefly the decease of this eminent investigator and able administrator.

— In a recent letter from Edward Desor, of Neuchatel, Switzerland, he states "that he has been diverted from his ordinary pursuits by that mischievous beast which has invaded us from North America, viz: the *Phylloxera*. We have some hope that we shall succeed in getting rid of him by means of a new treatment of the infested viper, viz: by *liquid* sulphurous acid, which has been applied recently with success at Geneva. Besides that I am prosecuting my investigations on some geological and pre-historical problems, especially the cups and archaic signs on the erratic boulders."—*F. V. H.*

— The Annual Report of the Vienna Imperial Geological Institute shows that the usual activity pervades this model institution. Additions to the special map of the empire have been carried on in the Central Alps, and from the Alps to the Venetian plain, as well as in Eastern Galicia, North-eastern Hungary and the Dneister region, while still other local surveys have been carried on in Austria. Collaberation with other geologists in Bohemia and Hungary has gone on, while the museum and library have been re-arranged in part, and heavy accessions made. (From a letter to Prof. F. V. Hayden by Count Marschall.)

— In a late number of Schultze's Archiv für Mikroskopie, Dr. A. Stecker describes the origin of the germinal layers in the chilognathous myriopods (thousand-legs). Oscar Schmidt describes the larval stages of two sponges (*Ascetta primordialis and clathrus*). W. Breitenbach describes some peculiarities in the maxillæ or tongue of *Vanessa* and *Catocala* sp., *Egyholis vaillantina* and an Australian moth allied to Ophideres, as well as the latter genus also, whose maxillæ are armed with stout spines.

— A good deal of fear and a stoppage in the sale of the shad in New Jersey and New York, has been occasioned by the discovery of ascarid worms about an inch in length occurring in the flesh and on the gills of these fish. On examination of specimens sent us by Mr. Apgar of Trenton, we find that the worms belong to *Ascaris*, or a closely allied genus. They are closely related to the ordinary ascarid or round worms which are abundant in the intestines and flesh of the cod, hake and haddock, and which we have always supposed to be rarely if ever injurious. Cases of sickness supposed to be due to the shad-worm have been reported in the papers, but it is doubtful whether any disease would show itself in so short a time. Similar, but much larger worms are common in the intestines of man and the domestic animals.

— Professor C. Semper of Würzburg, Germany, is desirous of obtaining specimens of North American salamanders, newts, hellbenders, mud-puppies or "fish-on-legs," *alive*, for use in his laboratory. Any specimens collected should be sent alive packed in wet moss, to Mr. Elmenhorst, care of Messrs. Matthiessen, Wiechers & Co., Jersey City, New Jersey, who will take them in charge and forward them to Hamburg.

— We have seen specimen copies of *Naturen*, an illustrated Norwegian monthly journal of the size of the English *Nature*, edited by Hans H. Reusch, and published at Christiania, Norway. It is devoted to the natural and physical sciences, is fully illustrated, and well supported by the leading Norwegian scientists.

— Butler University Scientific Expedition and Summer Tramp, will leave Indianapolis, June 20th, going by rail to Livingston, Ky., then on foot via Rock Castle River, Wild Cat Mountain, Cumberland Gap and Clinch Gap to Morristown, Tenn., exploring the caves and seining the rivers; thence up the Big Pigeon River, over the Great Smoky and Great Balsam Mountains, summits higher than the White Mountains and far more beautiful and wild; thence over the mountains of Chilowee and Nantahala (see Christian Reid's "Land of the Sky") up the Little Tennessee River to Estatoah Falls, through Rabun Gap to Tallulah Falls, the wildest and most beautiful series of cascades east of the Rocky Mountains. At Toccoa Falls, Georgia (about July 17th), the party will divide, a portion "marching through Georgia" to collect fishes, the others remaining in the mountains, returning

as they please. Objects: Natural History, Health and Scenery. Full instructions in Field Geology, Zoölogy, Botany. The two previous trips have been eminently successful, forty species of animals new to science having been obtained. For account of the last see *Harper's Magazine* for March. Tuition, $15.00. Board, $1.00 per day (average). Total expenses about $70. Eastern students join at Morristown. Address, Prof. D. S. Jordan, A. W. Brayton, C. H. Gilbert, *Directors*, Irvington, Ind.

— Judging by its bulletin for 1877 the Minnesota Academy of Natural Sciences is in a very flourishing state. Following the address of the President, Hon. R. J. Baldwin, is an essay on the Mycological flora of Minnesota, by Dr. A. E. Johnson, comprising 100 pages; a report on ornithology, by P. L. Hatch, M.D.; an article on Tornadoes and Cyclones, by Gen. T. L. Rosser, and the report of the Curator, A. F. Elliott.

— Prof. C. V. Riley, chief of the U. S. Entomological Commission has been appointed Entomologist to the Department of Agriculture. The fitness of the selection is manifest, and new energy and scientific activity will be infused into this important branch of applied science.

— Arrivals at the Philadelphia Zoölogical Garden: 1 ruffed grouse (*Bonasa umbellus*), purchased; 8 garter snakes, (*Eutænia sirtalis*); 2 water snakes (*Tropidonotus sipedon*), presented; 1 common bittern (*Botaurus minor*), presented; 1 red fox (*Vulpes fulvus*), presented; 1 rufous rat-kangaroo (*Hypsiprymnus rufescens*), born in the Garden; 1 gray fox (*Vulpes virginianus*), presented; 2 horned toads (*Phrynosoma cornutum*), presented; 1 cat bird (*Mimus carolinensis*); 1 robin (*Turdus migratorius*); 1 kingfisher (*Ceryle alcyon*), presented; 1 pied-billed Grebe (*Podilymbus podiceps*), purchased; 1 pinche monkey (*Midas œdipus*), presented; 1 Virginia deer (*Cervus virginianus*); 1 great kangaroo (*Macropus giganteus*), born in the Garden; 2 chimpanzees (*Anthropopithecus niger*), purchased.—*Arthur E. Brown, Gard. Supt.*

— The Smithsonian Institution is at present engaged in the preparation, for exhibition in the National Museum, of a series of plaster casts of American reptiles taken from the living or recently dead specimens, and carefully colored from nature. For this purpose it respectfully invites contributions of the following objects:

First. Specimens of any of the turtles and terrapins found in your vicinity, with information as to whether the collection embraces all the species known; and, if not, whether others may be looked for hereafter.

Second. The largest procurable specimens of serpents, with the exception of the poisonous kinds (such as rattlesnakes, copperheads, and moccasins), in reference to the transmission of which, further and special correspondence is requested.

Third. The various kinds of salamanders, water-lizards, or

ground puppies, to include the large hell-bender of the western waters; the mud pup or water-lizard of the northern lakes, or *Menobranchus;* the congo eel or ground puppy (*Siren* and *Amphiuma*) of the southern rice-fields, etc., as well as the smaller kinds found in damp places under stones and logs. A series of the frogs will also be acceptable.

All these animals should be suitably boxed and transmitted, as far as possible, alive; or, if dead, packed in ice, so as to insure their coming in good condition. The serpents require no special precautions in the way of packing; if of nearly the same size several may be sent together. If the disproportion be very great, there is, however, danger that the larger may devour the smaller. No rattlesnakes, copperheads or moccasins should be transmitted. The turtles should be wrapped or sewed up in some kind of cloth, so as to prevent friction. They should not be sent loose with the softer objects. Serpents require no moisture; frogs and salamanders should be packed with wet moss. Among the turtles should be included the soft-shell species, the true terrapins, the land tortoises, etc. Single specimens of any living reptiles, as well as larger numbers, including duplicates, will always be gladly received, and due acknowledgment made for the same. The largest procurable representatives of each species is desirable. Transmissions may be made by any express company, freight to be paid in Washington. Address the Smithsonian Institution.

— Prof. Semper during his late visit to the United States gave us the following recipe for a writing fluid for labels for alcoholic specimens. Use India ink dissolved in strong acetic acid; write and let it dry. It will stand for years.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Appalachian Mountain Club, Boston.—March 13. Prof. Edward S. Morse gave an account of a mountain excursion in Japan, adding incidentally much information in regard to the manners and customs of the people of that country. The recital was listened to with close attention, and Prof. Morse then answered many questions propounded by those present. A recess was taken to permit the club to reorganize as an incorporated body. Prof. Niles was chosen temporary clerk, and the necessary steps were taken to perfect the organization upon its new basis. A series of by-laws was adopted, differing in no essential sense from the old constitution, and the old board of officers were re-elected without change.

The necessary vote directing the officers to deliver to the new body all records, monies, etc., in their possession, was passed by the old organization. An exhibition of pictures was held by the Club in the gallery of the Boston Art Club, 64 Boylston street, the use of which has been kindly granted for this purpose during

the last week in March. The exhibition opened Tuesday, March 26, at 10 o'clock, A. M., and closed on Friday, the 29th, at 10 o'clock, P.M. Pictures of scenery among the mountains of New England were exhibited.

April 4, a special meeting was held to hear and discuss a paper by Prof. H. F. Walling on some recent views of mountain structure.

April 10, a communication from Prof. A. Lakes, on an ascent of Long's Peak, was read and an account of some barometrical observations in the White Mountains was received from Prof. F. W. Clarke.

CINCINNATI SOCIETY OF NATURAL HISTORY.—This Society held its regular meeting in its building, corner of Broadway and Arch streets, on Tuesday evening, 3d inst. This was the occasion for annual reports by the retiring officers, and the election of their successors. The report of the Treasurer showed a balance in the treasury of over $40,000, so invested as to produce an annual income of $3,500. The financial matters of the society have been very carefully managed by the Trustees, and hence these gratifying results. The Society owns its own buildings, and has no outstanding debts whatever.

The election of officers for the ensuing year resulted as follows: President, V. T. Chambers; Vice-Presidents, Prof. I. F. Judge and S. S. Cotton; Treasurer, I. A. Wright; Recording Secretary, Florien Giasque; Corresponding Secretary, I. W. Hall; Librarian, I. C. Shroyer; Custodian, Dr. I. H. Hunt. The Curators elected were as follows: Mineralogy, Dr. R. M. Byrnes; Palæontology, Ed. O. Ulrich; Botany, Davis L. James; Conchology, Prof. A. G. Wetherby; Entomology, I. W. Shorten; Ornithology. Charles Dury; Icthyology, Dr. D. S. Young; Herpetology, Frank W. Langdon; Comparative Anatomy, Dr. A. J. Howe; Astronomy, Prof. Ormond Stone; Physics and Chemistry, Prof. R. B. Warder; Meteorology, Prof. Geo. W. Harper; Microscopy, Fred. Eckstein; Archæology, Dr. H. H. Hill. The Society will now issue a regular quarterly journal of proceedings, the editors being Prof. I. F. Judge, Prof. G. W. Harper and Prof. A. G. Wetherby. The buildings are situated at the corner of Broadway and Arch streets, Cincinnati, Ohio, and are always open to the public.—*A. G. W.*

AMERICAN GEOGRAPHICAL SOCIETY.—March 21. W. Wright Hawkes, LL.D., delivered a lecture on the so-called Celtic monuments of Brittany.

ELMIRA ACADEMY OF SCIENCE.—March 15. Dr. W. H. Gregg remarked on time and the evolution theory, and F. Collingwood made a communication on the new moon of Mars versus the nebular hypothesis. Scientific progress in 1877 was then discussed, a phonautograph was exhibited, and singing and talking with Blossburg by telephones was listened to by the members.

NATIONAL ACADEMY OF SCIENCES.—This body convened in Washington at the Smithsonian Institution, on Tuesday, April 16, and remained in session four days, adjourning on Friday the 19th. The following papers were read before it:

"Formation and Structure of Alacrane Reef in the Yucatan Bank," by Prof. Alexander Agassiz, of Harvard College, Cambridge, Mass.; the Theory of Water-Spouts," by Mr. William Ferrel, of the United States Coast Survey; "Report on the Orbits of the Satellites of Mars," by Professor Asaph Hall, of the Naval Observatory; Mr. Raphael Pumpelly read a paper on "the Relation of Loess and Drift to Secular Disintegration;" "the Characteristic Invertebrate Forms of the Central Zoö-Geographical Province" by Dr. A. S. Packard, Jr. Dr. J. E. Hilgard, on "An Optical Ocean Salinometer." "Plan for Measuring the Velocity of Light," by Prof. Simon Newcomb, of Washington; "On the Force of Effective Molecular Action," by Prof. Wm. A. Norton, of New Haven, Conn.; "Remarks on the value of the result obtained for the Solar Parallax from the English Telescopic Observations," by Prof. C. H. F. Peters, of Clinton, N. Y.; "On the Vertebrate Fauna of the Permian Period of the United States, by Prof. E. D. Cope, of Philadelphia, Pa.; "On the discovery of Oxygen in the Sun," by Dr. Henry Draper, of New York City; "On Complex Inorganic Acids, by Dr. Wolcott Gibbs, of Harvard University, Mass.; "On improvements in methods of deep sea dredging, by Mr. Alexander Agassiz; "On Boyle's and Mariottes Laws," by Prof. Wolcott Gibbs; "On the Abrasions of the N. W. Coast of America," by Prof. Geo. Davidson, of San Francisco, Cal.; Photometric comparison of the Components of Close Double Stars," by Prof. E. C. Pickering, of Cambridge, Mass.; "On the Duplication of Geographical Names," by Dr. F. V. Hayden, of Washington; "Characteristics of some of the Lower Spectral Lines, by Prof. S. P. Langley, of Allegheny, Pa.; "A New Element of the Cerium Group, Prof. J. Lawrence Smith, of Louisville, Ky.; "On the Primary Zoö-Geographical Divisions of the Globe and their Relations," by Dr. Theodore Gill, of Washington; "On the Laws Governing the Movements of the Rocky Mountain Locusts," by Prof. C. V. Riley, Entomologist of the Department of Agriculture; "Photometric Measures of Certain Faint Stars and Satellites," by Prof. E. C. Pickering; "Recent Displacements in Utah, by G. K. Gilbert.

At the conclusion of Mr. Gilbert's paper, the Secretary read the address of the venerable and revered President, Professor Joseph Henry, to the Academy. After reading a number of papers by title, the proceedings concluded with a paper entitled "Supplementary notice on the paper whence came the inner Satellite of Mars?" read at the October session, 1877, by the venerable Professor Stephen Alexander, of the College of New Jersey, Princeton, N. J.

On the evening of the 17th, Prof. Arnold Guyot, of Princeton, N. J., read a paper on the Life of Louis Agassiz in America. Dr. Elliott Coues, in the absence of the author, read a Memoir of Prof. Jeffries Wyman, by Dr. A. S. Packard, Jr.

Communication was made by a representative of the subscribers to the fund, amounting to $40,000, presented to Professor Joseph Henry as a testimonial of their high appreciation of his services and his unselfish devotion to the cause of science, the principal of which is finally to go to the National Academy of Science, to form a fund to be known as the Joseph Henry Fund, the interest of which is to be devoted to assist the original research. The academy now holds a similar fund, "the Bache fund," the principal of which was left to the academy by its first President, Prof. A. Dallas Bache, and the income from it has been applied to the assistance of investigators in many of the most important branches of science. The list of contributors to the "Henry" fund, which is made up mainly in sums of $1000. embraces the names of well known persons in the large cities of the United States.

At a meeting of the Jewett Scientific Society of Lockport, N. Y., Jan. 25, 1878, Mr. A. F. Goodman read a paper on the sword-fish and its habits. Dr. S. F. Clark presented a paper recording his observations on ants. Feb. 8th, Mr. M. S. Burnett delivered a lecture on evolution, and Dr. A. W. Tryon remarked on the process of petrifaction.

Appalachian Mountain Club, May 8.—Prof. C. E. Hamlin read an account of Mt. Katahdin, Maine, illustrated by a model of the mountain. The councillors presented reports of their plans for the summer's work. A meeting of those wishing to form a section of exploration was held May 11th. On Saturday, May 18, 1878, an excursion was made to Blue Hill, Milton, Mass. On Wednesday, July 10, 1878, a field meeting will be held at the Fabyan House, White Mts., N. H.

American Geographical Society, April 16th.—Elial F. Hall read a paper entitled Gerard Mercator, his life and works, while addresses were made by the President of the Society, and others upon the state of geographical knowledge before Mercator.

Scientific Association of the Johns Hopkins University, April 3.—The regular exercises were contributions towards a history of Maryland Cambari, by Mr. Uhler; a paper on Nitro-sulpho-benzoic Acids, by Mr. Hart; Theory of Groups, by Dr. Story.

Boston Society of Natural History, April 17.—Mr. Richard Rathborn made an address on the late Prof. C. F. Hartt, and his Brazilian explorations.

Troy Scientific Association, April 15.—Dr. R. H. Ward read a paper on microscopic ruling and engraving.

SCIENTIFIC SERIALS.

AMERICAN JOURNAL OF SCIENCE AND ARTS, May.—Descriptions of new genera and species of Isopoda, from New England, by O. Harger. Notice of new fossil reptiles, by O. C. Marsh.

BULLETIN OF HAYDEN'S U. S. GEOLOGICAL SURVEY OF THE TERRITORIES. IV, No. 2. May 3.—The geographical distribution of the mammalia, considered in relation to the principal ontological regions of the earth, and the laws that govern the distribution of animal life, by Joel Asaph Allen. Description of new extinct vertebrata from the Upper Tertiary and Dakota formations, by E. D. Cope. Notes on a collection of fishes from the Rio Grande, at Brownsville, Texas, by David S. Jordan, M.D. A catalogue of the fishes of the fresh waters of North America, by David S. Jordan, M.D. Description of a Fossil Passerine Bird, from the insect-bearing Shales of Colorado, by J. A. Allen. (Plate I.) The Coleoptera of the Alpine Regions of the Rocky Mountain, by John L. LeConte, M.D. On the Orthoptera, collected by Dr. Elliott Coues, U. S. A., in Dakota and Montana, during 1873–74, by Prof. Cyrus Thomas. On the Hemiptera collected by Dr. Elliott Coues, U. S. A., in Dakota and Montana, during 1873–74, by P. R. Uhler. On the Lepidoptera, collected by Dr. Elliott Coues, U. S. A. in Montana, during 1874, by W. H. Edwards. An account of some insects of unusual interest from the Tertiary rocks of Colorado and Wyoming, by S. H. Scudder.

THE GEOLOGICAL MAGAZINE. April.—The age of the world as viewed by the geologist and the mathematician, by T. M. Reade. Geological time, by C. L. Morgan. What must be explained before the preservation of deposits under till is explained? by J. Young. Note on *Penæus sharpii*, by H. Woodward.

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.—April. On the phenomena accompanying the maturation and impregnation of the ovum, by F. M. Balfour (with an important résumé of latest discoveries). Notes on the structure and development of osseous tissue, by E. A. Schäfer. On the endothelium of the body-cavity and blood-vessels of the common earth-worm, as demonstrated by silver staining, by D'Arc Power. Experimental contribution to the etiology of infectious diseases, with special reference to the doctrine of Contagium vivum, by E. Klein. On the nature of fermentation, by J. Lister.

ZEITSCHRIFT FÜR WISSENSCHAFTLICHE ZOÖLOGIE.—March 7. F. E. Schulze continues his researches on the structure and development of sponges (family *Aplysinidæ*). The development of feathers, by T. Studer. Fertilization of the egg of *Petromyzon planeri*, by E. Calberla. On the formation of the egg and the amles of *Bonellia viridis*, by F. Vejdoosky.

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DIAMONDS.

BY F. M. ENDLICH.

QUOTING the words of Pliny we can say: "*Maximum in rebus humanis, non solum inter gemmas, pretium habet adamas.*"[1]

As far as our reliable records reach back into the dim and mystic ages, we find the diamond occupying a prominent position in the estimation of man. Above all other of its qualities, which at present determine its value, the superior hardness to all substances then known, seems to have impressed the Ancients. There appears to be but little doubt, that at very early ages the East Indians and the original inhabitants of the Chinese Empire knew the value of diamonds over all other gems. It is supposable, too, that the art of cutting was known to them, although it was not employed in the western countries until many centuries later.

Some doubt may appear whether the ancient Hebrews really possessed the diamond. In translations the word "shâmir" is rendered as diamond. We find that the breast-plate of the High Priest contained a "diamond" in the second row of precious stones. We furthermore find, however, that these twelve stones "were according to the names of the children of Israel," . . . "like the engravings of a signet, every one with his name, according to the twelve tribes." It seems improbable that they should have been able to engrave the diamond. Other passages occur where the diamond is used as a symbol of greatest hardness. One allusion is made that shows its application in the art of engraving; Jeremiah says: "The sin of Judah is written with a pen of iron and with the point of a diamond; it is graven upon the table of their heart." *Corundum* was known to the Hebrews, and

[1] Among all human things, not only among gems, the diamond is the most precious.

the comparative paucity of direct references to the diamond may lead to the supposition that some one of the corundum minerals was thereby meant. If a diamond was really spoken of, then this is one of the oldest reliable mentions made (600 B. C.).

Among the Greeks, Homer (1000 B. C.) uses the word "*Ἀδάμας*," but in his writings it signifies steel. There is no evidence that the precious stone known 600 years later, under the name of adamas, was among those with which Homer was acquainted.

Hesiodus, living about an hundred years later than Homer, uses the same word, but it merely designates some—to his mind—indestructible metal. Thus the sickle of Chronos, the helmet of Heracles, the chains binding Prometheus, and other similar instruments were composed of adamas. Roman poets and other writers have copied the idea and have constructed the gates to Hades and other durable objects from the same material. An interesting analogy, although a purely poetical one, may be found in the fact that the first seal rings, *Sphragides* of the Greeks, were manufactured from the chains confining Prometheus. The stones set into them were obtained from the rock to which the unfortunate thief was bound. Thus did man honor him who conferred a lasting boon by stealing fire from the irate Jupiter.

Later on, the term adamas was applied to the diamond. There is evidence extant showing that the cutting qualities of diamonds were utilized in Greece and Asia Minor about 400 years before Christ. Owing to the fact that no mineral or metal could produce any graven impression upon the diamond, it took the name above given, which literally means "not conquerable." Pliny adopted it, as did others of the more recent Roman writers. The former furnishes a learned description of the gem and its peculiar qualities, while the latter use the word to express a very high degree of hardness.

Pliny (born A. D. 23), states that six species of adamas are known. Of these five are probably only minute flakes of gold contained in some other mineral. The last one, however, he mentions as not occurring with gold, but found in India, in the form of crystals. From his description of the crystalline forms, the specimens he had under consideration might as well have been quartz as diamond. As he was acquainted with rock-crystal, however, and describes it elsewhere, we may conclude that he meant the

diamond. Pliny had a very thorough appreciation of its hardness, and repeats the fable then current, with reference thereto. He states that an adamas laid upon a new anvil, and struck with a new hammer, will shiver both, while the gem remains intact. Only by sprinkling it with the fresh blood of a male goat, can the excessive hardness be conquered. When the adamas is thus broken, however, it is shattered into innumerable small fragments so minute, indeed, that they can scarcely be seen with the naked eye. Bishop Albertus Magnus, of Southern Germany, in 1260, repeats the same statement, and sententiously adds, that the blood of the animal became far more efficacious, if he had imbibed sour wine and eaten some parsley just before being killed.

Owing to the rarity of the mineral this fable could be perpetuated for more than 1400 years, in countries far removed from those where the diamond was originally found.

After expressing his surprise that so disagreeable an animal as the goat should have so great a power over this most precious stone, Pliny states, that small splinters of diamond are set in iron holders, and used for the purposes of engraving and drilling. This shows a remarkable coincidence with the utterances of Jeremiah more than 600 years earlier.

At the time of Charles the Great (768 to 814) diamonds were highly prized as ornaments, and ever since that time they have steadily advanced in demand until the present day. During the reign of Louis XIV, in France, diamonds were much sought after, and some were brought to light that are famous for their beauty even now. Having at that time made an enormous stride in the favor of all people admiring mineral ornaments, diamonds have since then maintained their position. To-day they are a staple article in the market, and although new discoveries may somewhat affect their value, the demand is sufficiently great and constant to render them one of the most valuable among the precious stones.

Of all the countries which have furnished diamonds, India has been known as a prolific source for the longest period of time. Perhaps the most famous of all diamond fields there are the Golconda Mines. Thousands of people have found and many still do find employment there, although much of the wealth has already been exhausted. During the reign of Louis XIV, Tavernier visited the Orient to collect diamonds and precious stones for his

king. At that time (about 1680) he found 60,000 persons engaged in searching for diamonds in the mines of Ellore, in India. Next to India in importance is South America. The mines in Brazil were opened in 1727, and the best of them are situated north of the Rio Janeiro. On the Rio Jequitinhonha and Rio Pardo the most remunerative fields are found. Other placiers have yielded very good diamonds, however.

On Borneo, in the Ural Mountains, and in Australia, diamonds have been found. In the United States they have been collected at several localities, but only in comparatively isolated specimens. Diamonds have been obtained from North Carolina, Georgia, Virginia and California. The notorious occurrence of these precious stones in what was termed the "Arizona diamond fields," situated in North-western Colorado, is probably still too fresh in the memory of everybody to require special mention. Diamonds were certainly found there, but, to use a popular phrase, "they had not grown there."

Recently discoveries of extensive diamond fields have been made in Africa. They are situated on and near the Orange and Vaal Rivers, and are being worked with energy. Although their discovery dates back but a comparatively short time, it appears that the existence of diamonds there was already known during the last century. According to Dr. J. W. Morton, the natives have for a long time used diamonds from this locality to drill their stones, and formerly made periodical visits to replenish their supply of material.

As is frequently the case, the present impetus in that region to mining operations was given by the accidental discovery of a diamond. It was found in the hands of some children who were playing with the pretty pebble.

Wherever diamonds are found, they occur in redeposited material. River-drift or boulder-clay may contain them. No matrix for them has been recognized with certainty as yet, although it is claimed that the Itacolumite (flexible sandstone) of Brazil contains them. This assertion is scarcely proved, however, and even if it were so, this very Itacolumite is but the product of re-deposition. It may be regarded as a significant fact, perhaps, that the localities of North Carolina and Georgia, where diamonds have been found, are not far removed from occurrences of flexible sandstone. In the South African diamond fields the gems are con-

tained in a conglomeritic mass. It is composed mainly of volcanic material, but has evidently been deposited by water. In its general, physical character it may be compared to the "blue cement" of California, which is auriferous.

Of all these localities mentioned, India has produced by far the greatest number of celebrated diamonds. The largest diamond of which we have any knowledge, is mentioned by Tavernier. It was found in 1550, was in the possession of the Great Mogul at the time of Taverniers visit, and weighed 900 carats (1 Parisian carat = 205.5$^{mgr.}$). The present "Great Mogul" weighs 279 carats, and may be a portion of the original one.

Ko-hi-noor.—Tavernier gives the weight of the original Ko-hi-noor ("mountain of light") as being 787½ carats, but other reports place it a little higher. Weighing 186½ carats it came into the possession of the British crown, but was considerably reduced by cutting. Lately it has been recut, from rosette form to that of a brilliant, and now weighs only 106 carats.

Orloff.—The Orloff, weighing 194¾ carats, is in the possession of the Russian crown. It was purchased by Katharine II, for 450,000 silver roubles and 4000 roubles annuity. This diamond is cut in rosette-form.

The Persian.—In 1832 a diamond was found in the hut of a Persian peasant, by a traveler. It was there utilized for the purpose of striking fire. He purchased the stone and sold it at a high price. The weight of the "Persian" is 130 carats.

In connection with these three diamonds a very interesting observation was made by Mr. Tennant. The Ko-hi-noor, in its first cut, showed two natural planes of cleavage, the Orloff still shows one, and the Persian one. By reproducing as nearly as possible the original shapes of these diamonds, it was found that they probably are three fragments of one very large one. The aggregate weight would be 510¼ carats. It is quite possible, therefore, that these three formed the original Ko-hi-noor, the pride of Eastern nations. Tavernier mentions the fact that it had been cut down from its original size, which might account for the difference in weight. Few, if any gems have so prominent a position in legendary history as the original Ko-hi-noor. More than 5000 years ago the East Indian hero Kama, is said to have worn it in the "great war" (Maha Bharata). The discovery of the Persian led to the above results, as it was, to a certain extent, the incentive to the comparison.

Regent.—By far the most beautiful diamond of the French treasury is the "Regent" or "Pitt." From its original weight of 410 carats it has been cut down to 136¼. Its absolute purity and the elegance of its cutting (brilliant) for a long time placed it highest in rank among all the known diamonds. Its earliest history is somewhat obscure. According to tradition a slave found it in 1702 in Golconda. In order to hide it from the eyes of his employers he wounded himself in the thigh and placed the huge diamond within the wound. Having confided the secret of his treasure to a sailor, he accompanied him to sea. The sailor, however, stole the diamond and threw the slave overboard. In England the sailor sold it for 1000 pounds, lived merrily until his money was all gone, and then hung himself. Louis XV. of France bought it for two and a half millions of francs ($500,000). During the French Revolution, September 17, 1792, the crown diamonds were stolen, the Regent among them. Through the agency of an anonymous letter they were again discovered, hidden in a ditch in the Champs Elyseés. Although the Regent and many others were thus recovered, some of the most valuable stones could not then be found, among them the Sançy. After that the French Republic placed it in pawn with a merchant in Berlin. Napoleon Bonaparte recovered it again and had it set into the hilt of his favorite sword. Since that time it has remained in possession of the French government.

Sancy.—The Sançy first appears as the property of Charles of Burgundy. He lost the diamond in the battle of Nancy, 1477. Soon after this it came into the possession of Count Nicolas de Sançy. During 1589, Count de Sançy was in Switzerland, at a time when Henry III of France required securities for some loans he was then making. His loyal vassal immediately dispatched a trusted servant with the Sançy diamond as an offering to his king. Nothing was heard of the servant for a long time. Investigations showed that he had been waylaid and murdered. As his last resource, however, to save the property of his master he had swallowed the diamond, which was found after his body had been recovered. Later it formed part of the crown-jewels and was stolen, together with the Regent in 1792. After having been lost to observation for a long time the Sançy again reappeared in the family of the Napoleonids, who sold it to the Emperor of Russia for a half million francs, in 1830. This diamond weighs 53¾ carats and is cut in rosette shape.

Among the most prominent diamonds of earlier times are several that are noted for their color.

Florentine Diamond.—This stone is of a lemon-yellow color and weighs 133 3-5 carats. It was at one time the property of Charles of Burgundy, who wore it in his helmet. In the battle of Granson, on Neufchatel Lake, he lost it. A Swiss soldier picked it up and sold it to a priest. Pope Julius II. finally obtained it for 20,000 ducats, and eventually it was acquired by the Austrian crown, where it is to-day.

Dresden Diamond.—A very handsome green diamond is owned by the Saxon crown, and is preserved in the Green Vaults at Dresden. The color is a bright green with a bluish tinge; its weight 31¼ carats.

Hope Diamond.—Banker Hope, of Amsterdam, possesses a fine blue diamond of 4½ carats. It is cut in brilliant form, and closely resembles a deep blue sapphire in color. Formerly a blue diamond of 67 carats was among the crown-jewels of France, but it disappeared during the revolution.

Within recent years the two largest diamonds have been found in Brazil and Africa respectively.

Star of the South.—This diamond was found in Brazil in 1853, by a negress. Its original weight was 247½ carats, but by cutting it was reduced to 125 carats. The "Star of the South" has a slight pink tinge.

Star of South Africa.—About ten years ago this diamond was purchased from a native, and sold at once for 56,000 dollars.

Cutting.—It is evident that a large proportion of the value of a diamond depends upon the preparation it undergoes, in order to develop its beauty. No evidence is on hand to show that any of the ancient nations, East Indians and Chinese excepted, were acquainted with the art of diamond-cutting. From its very superior hardness, it is natural that it can be cut by no other material. In 1373 there was an association of "diamond-polishers" at Nuremberg, in Germany, but not until 1456 was cutting and polishing carried on as an art. Louis van Berquen, in Holland, at that time proceeded to rub two diamonds together, and finally produced a gray surface. The French word equivalent to our "cutting" is "*égriser*"—to make gray—based upon the first experiments. For a long time Holland had the entire monopoly of cutting diamonds, but finally other nations entered

into competition. In 1660, during the reign of Louis XIII, Cardinal Mazarin had the first diamonds cut for the French crown. Within late years the machinery for cutting diamonds has been greatly improved, so that the Ko-hi-noor was re-cut in the space of thirty-eight days, while the cutting of the Regent had required two years.

Two styles of cutting are employed in shaping the diamond, the *rosette* and the *brilliant*. The foundation for the former is the number two multiplied by three, for the latter the number four. A complete rosette cut will cover the entire diamond with faces of equal, triangular shape, while the brilliant presents a flat surface, surrounded by facets and a deep pyramidal or conical body. Numerous combinations of faces are added to increase the action of refraction. As will readily be seen from the most usual forms of crystallization of smaller diamonds, the brilliant cut can be executed with the least loss of material. It certainly presents the stone to best advantage.

Turning aside from the historical associations of the diamond, we have yet to consider its chemical and physical properties.

Among all minerals the diamond is by far the hardest. Next to it are the various corundum species, ruby, sapphire and others. This alone, to a mineralogist, is sufficient to distinguish it. Its specific gravity is 3.5295, about the same as topaz. The index of refraction is 2.439. Expressing the power of refraction in a more tangible manner, we may say that if we have a glass lens of certain dimensions which magnifies five diameters, an equal lens of diamond would magnify eight diameters. Upon being rubbed the diamond exhibits vitreous electricity. By passing an electric spark *over* a diamond, the stone may be rendered phosphorescent, and retains this quality for a short time. This fact, probably, has given rise to the popular supposition that all diamonds must "shine" in the dark. When looking at a cut diamond it is a good plan to have a dark back-ground, as the brilliancy of the flash thereby becomes more prominent.

Diamond crystallizes in the isometric system, and shows numerous combinations. Most frequently occurring is the octahedron with many combinations. Dodecahedra are found simple and in combination. Perhaps no other mineral exhibits so many different forms belonging to the isometric system as this one. Twins and hemihedral crystals are frequently found. Char-

acteristic of the diamond we may regard the curving of the crystalline faces. This occurs to so great a degree, that not unfrequently the specimens are nearly spherical.

Physically, we may distinguish three varieties of diamond: the crystal, the carbon and the anthracitic diamond. As seen above, the specific gravity of diamond is 3.52, while that of carbon is 3.01 to 3.40, and that of anthracitic diamond only 1.66. They show slight impurities, as compared with the crystals, but are chemically diamonds as also in their hardness. The carbon is put to practical uses, on account of its comparatively low price and great hardness. Instead of being colorless it is black, or gray, translucent only in very thin slabs.

Chemically, the diamond is carbon. At a high temperature it will burn, and be completely consumed, giving off carbonic acid gas. In an atmosphere of pure oxygen it will burn on, if once ignited. Between carbon points of a heavy battery, the diamond will become spongy, and turn to coals. In 1694 the first experiments of burning it were made. This was accomplished by means of a very powerful lens, concentrating the sun's rays. Much speculation became rife as to the behavior of diamonds under the action of great heat. Emperor Francis I, of Austria, conceived the brilliant idea of converting or melting a number of small diamonds together into one large one. In 1750 he placed a quantity of them, and some rubies, into a crucible, and subjected them to intense heat for twenty-four hours. After cooling, the rubies were found to be intact, but of the diamonds not a trace remained. Shortly before the French Revolution a Parisian jeweller asserted the possibility of exposing diamonds to a very high degree of heat without injuring them. He made his experiments before the famous chemist, Lavoisier. Maillard, the jeweller, had carefully surrounded his diamonds in the crucible with pulverized charcoal, and they withstood the fire perfectly. So long as the oxygen of the atmosphere can be excluded, the diamond cannot burn, and the only harm that might befall it would be a cracking from the heat. This, however, occurs comparatively rarely. Lavoisier, fully convinced by the demonstration, first offered a correct explanation of the phenomenon.

Impurities in diamonds are partly of a physical, partly of a chemical nature. Among the former must be classed cracks and cavities. The latter generally manifest themselves in discoloration

unequally distributed. Yellow, green, brown and gray are the colors most frequently observed. According to Brewster, many of the diamonds showing cavities under the microscope afford evidence, upon polarization, of having been subjected to pressure near these cavities at the time the diamond was crystallized. Such cavities, and slight accumulations of coloring matter were at first erroneously designated as chlorophylloid substances.

Yellow and brown diamonds owe their color probably to a very minute percentage of hydrated ferric oxide. It is an expensive amusement to analyze a quantity of diamonds sufficiently great to determine this point, so we are forced to base an opinion upon other than analytical proof. In the beginning of the nineteenth century a Parisian jeweler heated a brown diamond for some time, and, upon taking it out of the crucible, found that it had burned pink. This color, however, only lasted for about ten days, when the stone turned brown again. Since that time the experiment has been repeatedly tried, often with the same result. The chemical action in this instance consisted simply in driving off the water, so that the iron was contained in the diamond as ferric oxide. This imparts a pink color. Upon exposure to ordinary atmosphere, the original hydrated ferric oxide was again formed.

Green diamonds probably owe their color to an indefinitely small quantity of ferrous oxide. Whether the Dresden diamond is colored by the same material may remain an open question. The shade of green it exhibits is not one that would probably be produced by ferrous oxide. Possibly some organic salt of iron may produce the effect of color.

Gray diamonds usually owe their lack of transparency to the presence of innumerable microscopic cavities.

What the coloring matter of the Hope diamond may be can scarcely more than be guessed at. From analogy we know that certain salts of iron, organic matter and cobalt produce the same color. Which of these it is will most likely remain a secret. At a venture, the salts of iron might seem the most probable, considering the uniformity of coloring and the shade of the blue.

Regarding the formation of diamonds much has been said and written, and many well-conceived experiments have been made. More than any other agent, heat has been employed to reproduce these treasures of nature's laboratory. Thus far all experiments have failed to attain any available result. Some of the most emi-

nent chemists of the present century have expressed the opinion that diamonds owe their genesis not to the action of heat, but to an organic process. Newton, when studying the optical qualities of diamond, came to the conclusion that it must be a "coagulated oil." By means of electricity very minute crystals of carbon have been obtained, but all efforts to reach greater size have been baffled. Liebig regarded the formation of diamond as the result of organic decomposition. Though this view may not be perfectly tenable, it commends itself to the poetical mind from its allusion to the rejuvenated phœnix rising from his own ashes. With an ever-increasing knowledge of chemistry and the constant improvement of mechanical appliances, we may yet, some day, be able to produce diamonds that will compare favorably with those fashioned by the skillful hand of nature.

Practical uses of Diamonds.—Dependent upon its physical properties, the diamond is put to various uses. Perhaps the most prominent is that of drilling. The comparitive cheapness of "carbon" makes it possible to utilize this material for such purposes. Diamonds with sharp, crystallized edges are used for cutting glass and small fragments, and splinters are used to arm graver's tools. Dust is employed in cutting other stones as well as the diamond itself. Wherever a substance of very great hardness is required, diamond answers best. On account of its high power of refraction, diamond-lenses were formerly prepared, for the use of very high power instruments. The application of diamonds for purposes of personal or artistic ornamentation, may perhaps be considered a practical one in a certain sense. For such use the total absence of color and the high degrees of refraction and dispersion of light, place the diamond in the most prominent position among all precious stones.

Imitations.—It is natural that a stone so valuable as the diamond should frequently be imitated. Pastes are manufactured to-day, which only a very experienced eye can detect as frauds Admixtures of lead and, recently, thallium, impart to paste a high angle of refraction, thus producing "flashing" effect very near that of the diamond. Colorless quartz crystals and topaz are frequently cut and are destined to simulate diamonds. Zircon, if heated for a short time, turns colorless from a bright blood-red, and is cut. This too, in smaller settings supplies the place of the diamond.

Quartz and Zircon can readily be detected by the difference of specific gravity. The former is 2.65, the latter 4.30, while

diamond is 3.52. Besides the specific gravity the hardness will be decisive, both can be scratched by topaz. Topaz is more difficult to distinguish. Its specific gravity is 3.40 to 3.65, very near that of the diamond. In this instance, as well as in those of quartz and Zircon, an optical test is the most convenient. In 1858, the Brazilian ambassador Lisboa, presented a "diamond" at the court of Vienna. It had been admirably cut in Paris, and weighed 819 carats. By experts it was valued at more than fifty millions of francs. One of the mineralogists called in consultation applied a very simple optical test, and found the stone to be a topaz. He placed a lighted candle upon a table, walked about 12 to 15 feet away from it, and looked at the light through the diamond, which he held close to his eye. In every facet *two* little flames appeared side by side. As only those crystals have single refraction, which belong to the isometric system (in which the diamond crystallizes) the specimen under question, having double refraction, could not possibly have been a diamond. When looking in this manner at a candle, the diamond, as well as the paste will show but a *single* flame in each cut face. Paste can readily be distinguished by its inferior hardness, as topaz will scratch it.

Price.—The price of diamonds is one that fluctuates, dependent upon the demand and supply. Within certain limits it may be regarded as definite, but when the value of very large stones is to be estimated, the same rules for its determination cannot be followed. Diamonds are usually separated into three classes, and they are termed as being "first water," &c. Besides these three, there is the boart and carbon. These two latter varieties are utilized for purposes of cutting, sawing, drilling, &c. They are sold by the carat as other diamonds. One carat of carbon costs about 6 dollars.

Diamonds used for purposes of ornamentation advance very rapidly in price as their size increases. If, for instance, one carat should cost 100 dollars, six carats will not cost 6 × 100 dollars, but 6 × 6 × 100 or 3600 dollars. This rule does not apply to inferior stones, but is followed, within certain limits, in determining the value of the best class of diamonds.

Independent of its high price, however, which is always a recommendation to the favor of civilized man, and woman too, the diamond will ever hold its own prominent position, on account of its great intrinsic value.

MOUND-MAKING ANTS OF THE ALLEGHENIES.

BY REV. HENRY C. McCOOK.

THE following notes are substantially extracts from an article printed in the Transactions of the American Entomological Society.[1] They relate to the familiar mound-making ants which inhabit the mountain regions of the Atlantic States, particularly Pennsylvania. These are insects in form as represented in the accompanying figures, the head and thorax being of a fallow or reddish color, the abdomen a glossy black. There are three forms of workers, the major, minor and dwarf, by whom the entire external economy of the formicary, and for the most part the internal also, is conducted. The females closely resemble the workers-major, but are larger, more robust, and in the virgin state are winged. The males are winged, are smaller than the females, from whom they are further readily distinguished by the smaller head, an additional segment to the abdomen and the different form of the same. In the original paper these ants are referred to as *Formica rufa*, the name which they bear (identified by Frederick Smith, of the British Museum) in the collection of the Entomological Society. They very closely resemble these ants, but on the authority of Dr. Auguste Forel, the author of the "Swiss Ants" (Les Fourmis de la Swisse), to whom specimens were sent, they are referred to in the following notes as *Formica exsectoïdes* Forel, a new American ally of *F. exsecta*. Their habits do not greatly differ from those of *F. rufa* of Europe, but are nearly if not quite identical with those of *F. exsecta*.

FIG. 1. Worker-Major. The lines beneath the latter figure show the natural length of the three worker forms.

It is further premised that the observations given below were made while encamped in the midst of a colony, or "ant city," of more than 1600 nests, situated upon the eastern slope of Brush mountain, Pennsylvania. These nests are conical elevations of various sizes, the largest measured being fifty-eight feet around the base, twenty-four feet over the top, and forty-two

[1] Vol. VI, 1877, p. 253, sqq. The entire paper is published separately by John A. Black, 1334 Chestnut street, Phila.

inches in height. The mode of building the hills, which are honey-combed with regularly placed tubular galleries, is as follows. The mason work was greatly stimulated by a shower of

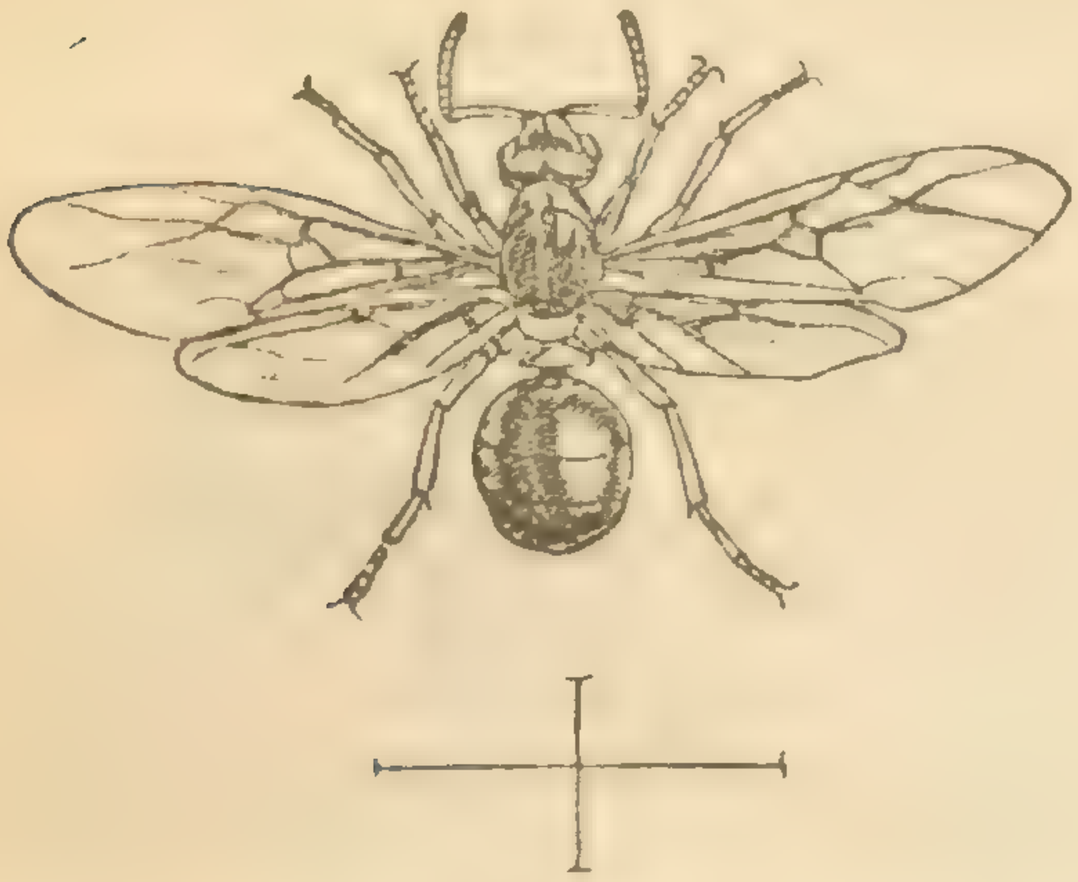

FIG. 2. Female.

FIG. 3. Male.

rain, and was indeed scarcely observed (beyond excavations of the underground galleries) before the rain-fall.

Building Galleries.—1, Fig. 4 represents a covered way or gallery six inches long, which started on the foundation three or four inches below the surface of the field, and rose up toward the half-

FIG. 4.—Covered Galleries.—1, horizontal gallery; 2, vertical gallery.

cone at an angle a little less than 45°. When first seen it was an open gallery or ditch, and was observed until it was entirely cov-

ered over except one door or round hole near the top. The work progressed by the continuous addition of earth pellets to the outer edge. The pellets were carried in the mandibles of the ants, and were usually pressed into position. The springing of the arch was plainly seen, the two sides slowly approaching each other in irregular lines as shown at *a a*. Gradually two points drew nearer and nearer, until they well-nigh touched. It was quite exciting to watch now the delicate manipulation of the architects. Here comes a worker with pellet of larger size; she climbs the arch, reaches over, holding the while by her hind feet, and drops the ball of soil into the breach. The bridge is made. And now with surprising rapidity it is widened until the roof of the arch assumes the appearance indicated at *b b*. Circular openings or doors are habitually left in the work, through which the ants are moving back and forth, apparently working upon the inside to strengthen the arch. As sections of the building are completed these doors are closed, so that they are plainly but temporary arrangements for the convenience of the masons.

On other parts of the foundation similar structures were going up. At 2, Fig. 4, was a section of a vertical column, one side of which had been cut away. It was two inches high, and one inch across. The ants were working upon this in the same manner as described above. They built not only from the bottom up, but from the sides across. The central opening in the figure was finally closed, leaving, when the work ended, the opening at the foot of the column. The circular gallery thus enclosed was one-half inch in diameter, which is about the usual dimensions. The work of construction was not confined to the space which, as in the above cases, was the original site of the cone. Having occasion to lift up a fragment half the size of one's head, which had been thrown to one side, I saw that the section had already been made the nucleus of a new mound. Columns, corridors and halls, corresponding closely with those outlined upon the under face of the fragment, had been erected, which were thus quite united to the fragment. In one of the halls was a small collection of dead ants. The greater portion of one day was spent in studying and recording the work upon this one hill. Other drawings were made from different positions, but the method and result were the same. As the activity occasioned by the shower

continued for the remainder of our stay, I had full opportunity by subsequent observations to verify my notes.

Fig. 5 is another example of architecture drawn from the same broken hill. The figure represents a double gallery which was built up against the perpendicular side H of a hole cut by the spade in removing the cone. The gallery *a a a* was carried along the base of the side three inches, and then upwards toward the surface. The gallery was widened at two points, *c c*, to one and a half inches, as though intended to serve as store-rooms for cocoons. Galleries opening downward communicated with these enlargements. At *e* ants were arranging pellets along a projection on the side, for what purpose was not apparent.

My attention was next directed to a large hill, which with its surrounding hill-cluster was on my regular "list." I took this plan of keeping several hills under regular, daily, and indeed for much of the time hourly observation, for the obvious reason that thus I could become "acquainted" with the workers, could trace the work done, and confirm or condemn previous conclusions as the case might be. In this hill a track had been made by one of a herd of cattle grazing in the field. The foot of the steer had left an irregular depression measuring nine inches each way, in depth eight to nine inches, the lower margin being six inches from the base of the hill.

FIG. 5.—Covering a double gallery *a a a*, and chambers *c c c*.

Engineering.—The lower part of this track is shown at Fig. 6,

in order to exhibit what seems very much like a deliberate and well planned system of engineering, in filling up the hole. The drawing is one-half natural size. At *A*, *a*, the original hill is shown, marking the southern limit of the foot-print. The work of filling up against this had begun. From the lower point *A*, marking the outline of an arc, were the following works: *b*, a circular column one inch high, from the upper base of which, a broad bifurcated plateau was being extended; next to this was an oblong mound *c*, one-half inch high, and beyond that, marking the opposite limit of the track, a lunette *d*, one inch high. Beyond this, toward the base of the hill, and parallel with the arc *b*, *c*, *d*, was thrown an arc of like but smaller lunettes *i*, *i*, *i*. At *e* and *f*, were lunettes similar to *d*, and at *g*, a scolloped mound. These elevations, with that at *k*, *k*, surrounded the cavern *h*, which was the deepest part of the cattle-track The plan of operations is very plain; from the little raised columns and mounds figured above, the work of covering in could proceed with the greatest advantage. The elevations *b*, *c*, *d*, were evidently guaged by the height of the edge of the hill at *A*, thus marking the depth of the track on that line. The diminishing depth was met by a corresponding lowering of the lunettes *i*, *i*, *i*, and at other points in the excavation the same facts held good.

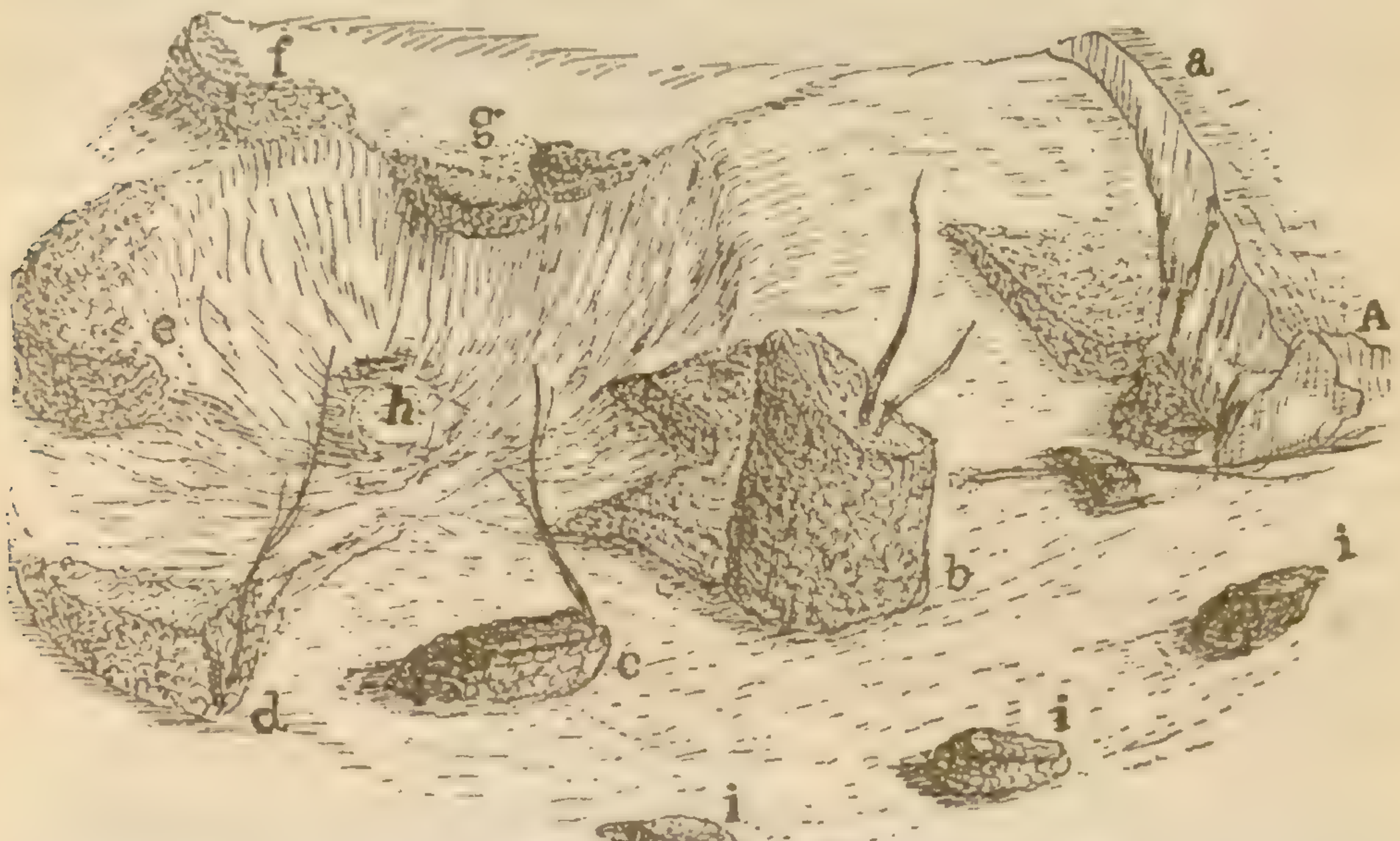

FIG. 6.—Engineering work; filling up a break.

The above operations began on Saturday morning; on Monday morning the cavity was two thirds filled. Very strangely the work did not connect with the face of the break towards the sum-

mit of the hill, but a deep trench or gallery had been preserved all the way across, the wall being maintained intact. Nor was there any appearance here of the formation of the galleries above described; it was dead filling in. In one of the little hollows the shells of cocoons, out of which antlings had just been delivered, were piled up, apparently to assist in the filling. I had before observed these being carried from this hill and deposited on the stones outside. A number of straws were worked into the columns, evidently as braces. A few feet from this large mound was a small hill, one of its off shoots, which even before the rain had shown much activity in construction, for the surface was covered with fresh pellets. The shower had inspired the inmates of this young community with amazing zeal.

Underground Galleries.—Thus far we have been dealing with that part of the formicary which is above ground and is apparently the most considerable. There is, however, a hidden portion which is immense in extent, and must have vast importance in the economy of the community. Every hill furnishes a fair measure of the extent of the underground system of galleries connected therewith; for it is reasonably certain that the entire bulk of soil in each mound has been excavated and brought up from the galleries beneath the surface. The average width of the upper galleries is about three-eighths of an inch; the maximum width not exceeding one-half inch. The underground galleries are probably of the same size. A glance at these mounds, therefore, at once gives indication that an extraordinary system of subterraneous galleries must be connected with each formicary, though I made no satisfactory examination into the arrangement of this system; this might have been done, perhaps, by sinking a deep trench close to a mound and extending it for some distance. But the soil is so very full of stones that even thus the results might not be satisfactory. No doubt the ants descend to considerable depths, utilizing the stones in various ways, for example for roofs and walls, as they do upon the surface. It would hardly seem possible to preserve any great regularity in the course of these underground ways which must constantly be diverted by the stones. But they undoubtedly can be held to a general course, and are carried with great directness from point to point, when it is desired to communicate with the trees and feeding places. I was able in one case to trace the extent of the galleries near the surface in the follow-

ing way. Tapping upon a hill whose inmates were in a particularly "nervous" condition, the ants issued in excited hordes not only from the doors of the mound, but from various points on the surrounding surface. Taking a principal centre of excitement, four or five feet distant, a stone underneath which was an entrance to the galleries, I again agitated the ground. The ants as before issued from the surrounding surface, chiefly upon a line running eastward, up the slope. At the limit of excitement, which was something less than before, I once more agitated the stones and earth with like results. Thus I traced this surface gallery eastward about 60 ft., where the excitement under the above treatment ceased at an oak tree. I am satisfied that as a rule the central formicary or hill communicates with the trees which serve for feeding grounds, by galleries as long as or much longer than this.

Adding Stories.—On the east and west sides of the hill, several inches from the top, deep fissures had been cut, looking like sun cracks, the lower edges of which were being built up, and the upper bent over. An additional story was thus being added to the cone. Here grass-straws were strewn over the summit, and others which I threw upon the hill were dragged into place and utilized with skill. This story was well nigh completed by Monday morning. The building was carried forward (and such was the case on the large hill and on others observed), by erecting warts or small cones upon the surface and around the openings or doors of the galleries, and filling between them. I could trace the evident outlines of galleries laid out.

Entrances or Doors.—The principal entrances to the formicary are at the foot of the hill. They are commonly placed around the entire circumference of the mound, and are arranged in two, three, or more circular rows, one above another. At certain points where, apparently, there is need of an especial vomitory, the gates are much multiplied. Besides these, there are openings at irregular intervals upon the entire surface of the cone. These are not numerous, but sufficiently so to allow easy approach to and exit from the more elevated portions of the mound. The main dependence appears to be upon the lower gateways. It would seem, at first thought, that there could be no real necessity for so many doors; but one who has witnessed the rapidity with which the myriads of workers swarm upon the surface when their nest is attacked will at once perceive the economy of these numerous

gates. The doors are simply the surface openings of the galleries with which they correspond in size.

Huber declares it to be one of the fixed habits of the fallow ant (F. rufa), of Switzerland, to close the gallery-doors at night and re-open them in the morning. The most careful attention could discover no such behavior among the ants at Camp Riddle. At no time during the whole week was there observed any sign of attempt to close up the galleries. Even during the heavy storm of rain referred to, the doors which were closely examined at various hours of the night, remained open. It would have been more satisfactory could an observation have been made during a fall of rain in the day time, but I have little doubt on this point, and none at all on the ordinary night-condition of the doors. This is certainly a remarkable variation in habit. It may possibly be accounted for by the presence in Switzerland of some nocturnal enemy, from which the American congeners are free.

Before taking up in detail the life habits of our mound builders, a comparison and contrast may be allowed which may give a popular illustration of the immense labors of the fallow ant. I have calculated the cubic contents of one of the largest hills to be, in round numbers, two millions of cubic inches. Let us estimate the bulk of an ant equal to that of a cylinder three-eighths of an inch high and one-sixteenth of an inch in diameter at the base. We have thirty-five one hundred thousandths of a cubic inch as the bulk of a single ant, or two thousand eight hundred and sixty insects to the solid inch. The size of the builder is therefore to the size of the edifice as *one* to *fifty-eight thousand millions*. Let us compare this with a corresponding estimate of the work of man (taking his bulk at four cubic feet), as wrought upon the great pyramid, reckoned to contain two hundred and seventy-six millions of cubic feet.

Man's bulk to his building is as 1 : 69 millions.

The Ant's " her " " 1 : 5800 "

The figures are given roundly, without strict verification; they show vastly in favor of the mechanical energy and industry of the insect, if such comparisons may be allowed to show any thing, which is perhaps doubtful. They may serve however to impress some minds more vividly than other methods, with the immense activity which marks the wonderful realm of insect life. The advantage is yet more striking when the period of time consumed

in erecting an adult hill, from 3 to 7 years, is compared with the thirty years which one hundred thousand men spent in building the pyramid. Moreover, as will also appear, the superstructure or hill, is by no means the whole of the formicary. A vast system of subterraneous galleries penetrates the earth to unknown depths and distances, requiring labors which in magnitude may well be compared with those which excavated the catacombs of Rome.

Sentinels.—I observed on the tree-paths a movement that had the appearance of some policy of police. Workers, with the normal round black abdomen, were scattered at intervals along the trunk. They did not seem to belong to the line of ascending foragers, but rather to be stationary, as though they were sentinels or policemen. They were active in challenging with their antennæ the repletes who were on the return, and were quick to resent any interference made by intruding a finger or straw upon the path. This statement is made with reservation, as I was not able fully to satisfy myself that the facts revealed a fixed habit. The point, however, is well worthy of future investigation. There is at least a probability, from analagous habits of the ant, that the individuals referred to above were indeed sentinels as their behaviour indicated. It is a well established fact, in the economy of ant hills, that sentinels are posted at or near entrances, and common avenues of approach. I satisfied myself of this by very many observations and experiments, which it is not necessary to relate in detail. It will suffice to say that on every occasion of approach of any object to a hill or entrance, workers instantly sprang upon the surface. These sentries were constantly seen lurking just inside the gallery doors, whence they issued with every mark of intense vigilance and excitement the moment a finger was intruded or the smallest object dropped near them. Frequently they patrolled the vicinity of the gates. They attacked every intruder with the utmost promptness and intrepidity. It gave subject for great wonder to note the rapidity with which an alarm was communicated throughout a large hill. Two hills in particular, whose inhabitants were for several days in a condition of high nervous excitement, attracted attention. Standing a yard or more from the base, I would agitate with my foot a stone which evidently had communication with the interior of the mound. There was scarcely an appreciable interval of time ere the whole surface of the cone

was covered with insects. The black and red masses whirled in indistinguishable mazes, producing a very perceptible buzzing sound by their rapid movements. Even for several feet beyond the hill, on the opposite side, the excitement extended, and was manifest with almost equal rapidity.

Tree-paths.—The word tree-path, as used above, perhaps needs a brief explanation. It was observed that the ants ascending and descending the trees invariably kept to a beaten track, two or more inches in width. In many cases this track or tree-path was stained, the entire length of the trunk, a brownish-yellow color, caused doubtless by the formic acid which the ants secrete. The position of these tree-paths is determined by the situation of the hill to whose domain the tree belongs, for each community has its own special feeding grounds upon which intrusion is rarely if ever made. The tree-path is located habitually upon that part of the trunk which directly faces the hill. This was verified by observations upon a very great number of trees.

Winter Habits.—There are several inferences, more or less conclusive, concerning the winter economy of the fallow ant which we may draw from the facts. First, the ants dwell within their formicaries during winter, and make no attempt to modify the surface surroundings. Second, the vast majority of the community, together with the fertile queens, larvæ and cocoons occupy the underground galleries. This appears from the fact that but one young queen and comparatively few workers of the various classes were found in the hill galleries. Third, the composition of the mounds is such as to ensure, in the central parts, a good degree of protection against ordinarily severe winters for the few ants that occupy them. Fourth, the vitality of the ants is sufficient to keep them active within the hills during all ordinary seasons. Fifth, it is yet more evident that the occupants of the underground galleries are not torpid during ordinary winters, if ever, but exist in a state of considerable activity. Finally, it would appear that the ants are able to spend the winter in the active state without regular and ordinary supplies of food.

I do not advance this last opinion with any great degree of confidence. The mysteries of the underground galleries still veil the facts that would solve the question completely. But all the known facts point to the above inference. I had thought that the tufts of grass which grow upon many hills, and which evi-

dently grow at the ants' consent, might be preserved, not only to strengthen the architecture, but to furnish at their roots sustenance for aphides. Accordingly, at a visit made October 26, 1876, a cold, snowy day, I carefully searched for aphides upon the roots of the grass, but found none. Mr. Kay's search was equally fruitless. The roaches found in such numbers by Mr. Kay, and also by myself, are doubtless simply squatters upon the emmet territory. However, it must be considered as still unsettled whether our mountain mound-builders feed during winter, and if so, what are the sources of their food supply.

Beetles.—The possibility that the beetles, certain species of which are well known to frequent the nests of ants, might be in some way concerned in this interesting query, did not escape my attention. But I was never so fortunate as to take any beetles in the hills either during the summer or fall visit. This was doubtless chiefly owing to my ignorance at that time of the size and appearance of the insects, and the best mode of capturing them. I hope at another visit to remedy this deficiency. Dr. Horn informs me that the spring is the best season to search for these domesticated beetles. Among the ants collected in mid-winter by Mr. Kay, and sent to me as specimens, I found one beetle. It is a small insect, about one-tenth of an inch in length, of a dark claret-brown color, quite closely resembling in this respect the ants among whom it dwells. It is determined by Dr. Horn as *Tmesiphorus costalis* LeConte, and belongs to the Clavigeridæ. The discovery of this beetle in midwinter, together with the fact that the beetles are found in abundance with the ants in early spring, show these insects to be closely connected with the winter life of the ants, if not with their winter food supply.

Dr. John L. LeConte, so widely distinguished for his thorough knowledge of the Coleoptera, has shown me the following species collected by himself from ants' nests. Two of these, taken from formicaries of our Allegheny Mountain mound-builders, I have been permitted to figure. They are drawn in order simply to give a general idea of their appearance, and not for systematic description. The most interesting of these is perhaps Fig. 7, 1, *Atemeles cava* LeConte, which, like the Clavigeridæ, is furnished with tufts of hollow, hair-like tubes, on the sides of the abdomen. From these tufts a sweet secretion exudes, upon which the ants feed, as upon the honey-dew of the aphides.

A. cava is a brown-colored insect, about one-fifth of an inch in length. Specimens were found with fallow ants in Columbia Co., Pa.; in Michigan, Maryland and Illinois. Those from Illinois were found in nests of *F. rufa* (?) in large numbers. One of the ants taken with the beetle still holds in its mandibles, firmly clasped even in death. one of these household treasures. The other specimens figured are destitute of the hair-like tufts, and probably serve simply as scavengers, or are permitted to remain as "squatters" in the formicary, for some purpose, the economy of which is unknown. *Cedius ziegleri* LeConte, Fig. 10, 2, was taken in a hill of *F. exsectoïdes* at Bedford, Pa. It has short elytra, the color is brown, the length is one-tenth of an inch. On each of the first pair of legs are two spines, one situated (apparently) at the base of the femur, the other on the trochanter. The remaining specimens were also taken at Bedford, Pa., and are an undescribed species of Homalota, and an unnamed species of Oxypoda. They are small brownish insects, with a slight pubescence.

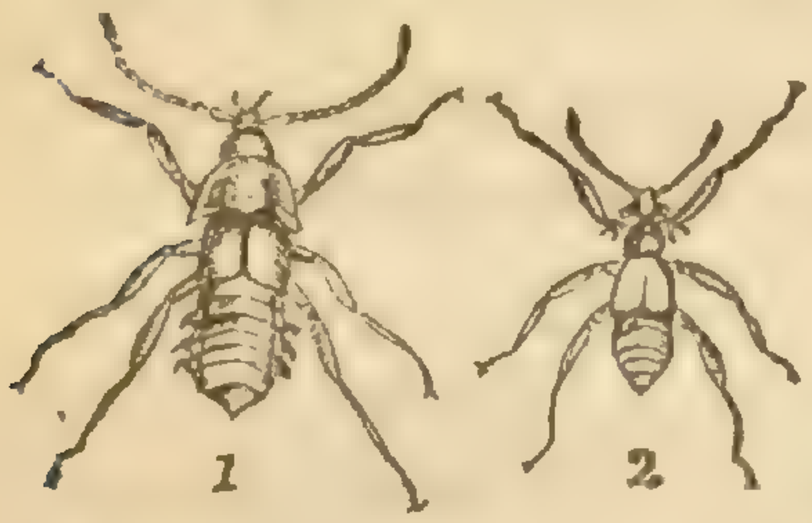

FIG. 7.—Beetles found in nests of F. Exsectoïdes. No. 1, *Atemeles cava* LeConte. No. 2, *Cedius Ziegleri* LeConte.

Lepidopterous larvæ with Ants.—I introduce here as bearing upon the general matter of ant-food, and the relation of ants to myrmecophilous insects, the following observation. During the early summer of 1877, I had frequent opportunity to note the habits of a large colony of black, shining ants, *Formica fusca*, whose formicary is established at the edge of a grove on the farm of Mr. George B. Lownes, Delaware Co., Pa., nine miles from Philadelphia. The ants were found scattered through the woods, within a circuit of many rods from the nest. June 18th, I observed a column of these ants ascending a young wild-cherry tree, near which grew several tall stalks of the black snake-root or bug-bane, *Cimicifuga racemosa*. While watching the ascending column I noticed an ant moving upon the round blossoms of this plant. Attracted by some peculiarity in its movements I fixed my attention upon it, and saw it to be in attendance upon a small green grub about one-half inch long, which proved to be the larva of a butterfly, probably some species of Lycænidæ. The lower segments of the abdomen were continually gently stroked

by the antennæ, in the familiar manner of ants when soliciting honey-dew from aphides. This novel behavior was of such interest that I placed the ant under close continuous observation for more than two hours. During this time the strokes were repeatedly interrupted by short excursions up or down the plant, the ant always returning and renewing the solicitation. The ant always occupied a position below the grub, and directed her strokes toward the head, which, however, generally fell upon the lower part of the body. The larva did not remain stationary, but several times moved its position, slowly creeping around the stem. I ceased observation at noon, and returned to the grove at 4 P. M. The grub was in about the same position, and was attended by the same (or another) ant which was accompanied by a companion. The same behavior observed in the morning was continued until 5 P. M., when I captured ants and grub and took them home. A number of the same larvæ in different stages of growth were found on the same plant in various parts of the grove. I was only able to observe that the ant continued to attend the grub under confinement just as in the woods. But preparations for a journey to Texas, compelled me to suspend observations. Although satisfied that the object of the ants was to secure some kind of refreshment from the larvæ, I was not able to note any secretion on the grub, or anything like the actual taking of food by the ant, although the mouth organs were applied to the last segments.

A casual mention of my discovery was the means of opening communication with W. H. Edwards, well known for his valuable works upon the Lepidoptera, who later in the summer (as I infer), had observed the same fact. In comparing notes it was found that the larva observed by him in West Virginia, was also of the Lycænidæ (*Lycæna pseudargiolus*), and that it was domiciled upon the same plant (*Cimicifuga racemosa*). Two species of ants were seen attending the larvæ, one of which was sent to me and proves to be identical with the European *Prenolepis nitens* Mayr. Mr. Edwards kindly communicated to me the details of his own observations, which he has since given to the public in the Canadian *Entomologist*. As examined by me under the microscope, the larvæ prove to be possessed of organs upon the upper part of the last segments, apparently designed or fitted for the exudation of some fluid. Mr. Edwards also directed my attention to a paper

by M. Guenèe, in the "Annales de la Sociètè Entomologique de France," Ser. iv, tome 7, 1867, pp. 665—668, which I have consulted. The paper is brief but exceedingly interesting, and gives a full description, illustrated by figures, of organs found upon the eleventh segment of the larva of the butterfly (*Lycæna bætica*), whose protrusion from two openings near the ninth and last pair of stigmata, was observed, and the action and organ figured and described. At the summit of the tenth segment the author found another single opening, placed transversely, and surrounded by a projecting border around which the granulations which cover the whole body of the larva are especially massed. Out of this sort of button-hole, and at the middle, rises, at the will of the grub, a species of hemispherical, transparent vesicle, which gives passage to a serous liquid sufficiently abundant to form a large drop, which is reproduced whenever it is removed. The larva does not secrete this liquid except when disturbed, imitating in this respect the *Cucullia* and many other larvæ which disgorge at the mouth a colored liquid, with the intention, doubtless, of repelling those who molest them. M. Guenèe ventures no opinion as to the economy of this exceptional structure. But, his description throws great light upon the behavior of the ants as recorded above There can be little doubt that the gathering of a serous liquid, like that observed by M. Guenèe, upon *Lycæna bætica*, was the object of the attendance of the ants of *Formica fusca* upon the Lycænid larva as observed by myself. This larva (in alcohol) was placed in Dr. Leidy's hands for examination, under the microscope. He found on each side of the two (or three) last segments, on the dorsal surface, a prominent, circular, brown-colored glandular looking body, with a central depression. These glands were quite distinct from the spiracles, which are not represented in the accompanying cut. Fig. 8 shows the appearance of these glands as situated upon one side of the terminal segments. It is possible that the last three segments are here represented, the last (twelfth) being contracted. Dr. Leidy found no opening at the summit of the tenth or other segment, corresponding with the button-hole-like secretory gland described by M. Guenèe. The above facts are all of very great interest, and may

FIG. 8. Glands upon terminal segments of Lycænid larva, attended by *Formica fusca*.

prove to be another important factor in solving questions concerning the food supply of ants under both ordinary and extraordinary circumstances. Mr. Edwards is now pushing his observations upon the Spring larvæ of this butterfly, assisted by the microscopic skill of Prof. J. Gibbons Hunt, M. D., of Philadelphia.

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THE SMALLEST INSECT KNOWN (PTERATOMUS PUTNAMII).

BY HON. J. D. COX.

THE minute size of this species, which is said to be the smallest insect known, is probably the reason why it has been so little observed, and will justify a somewhat detailed description of a specimen which was caught and mounted in balsam last July.

I was examining the scissor-like mandibles of a leaf-cutter bee (*Megachile centuncularis*), when I noticed upon the surface of the water in which the larger insect was dissected, a mere mite which seemed to have life. Upon transferring it to a smaller cell of water and putting it under the microscope, it proved to be one of the most beautiful little creatures of the insect world, and a rarity which made it no ordinary prize.

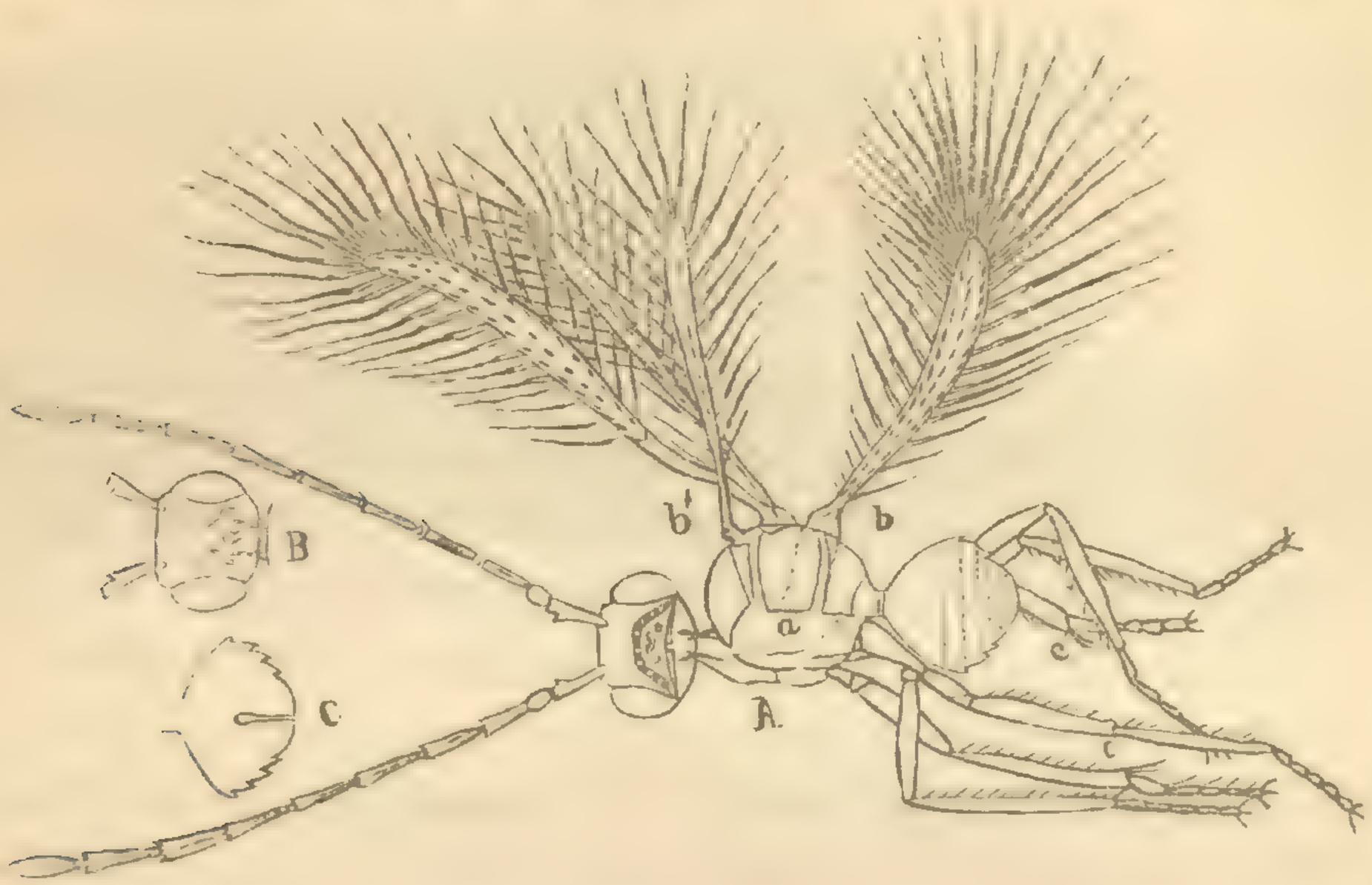
Whilst it was not difficult to identify it as the *Pteratomus Putnamii* from Prof. Packard's description in the "Guide to the Study of Insects," it was also evident that the specimen which the Professor had before him in making his drawing and description, had been injured, and shorn of some of its parts, and that something might be added to our knowledge by putting the "winged atom" in shape for permanent preservation.

The first suggestion as to method was acted upon at a venture, and it turned out a rather lucky hit. A clean slide and cover, and the soft balsam were at hand. Her littleness was taken carefully on the point of a needle, dried against a bit of blotting paper, immersed in a drop of balsam and the cover put on, leaving the arrangement and display of the parts almost wholly to the effects of capillary attraction.

The cut is from an accurate tracing by means of the camera, and except as to the position of the wings, will give at once a correct idea of the little creature. The wings were forced somewhat out of place in the mounting, but with the aid of the binoc-

ular microscope there was no great difficulty in seeing the proper connection and natural places of the parts.

The body was found by micrometer to be twelve thousandths of an inch in length, the antennæ, twenty thousandths. The head is comparatively large and plump, the longitudinal diameter being to the transverse as eight to five. The compound eyes when



seen in outline show eleven facets in section from front to rear; they are of a bright brownish-red color. Three ocelli or stemmata are seen on the top of the head, the middle one lunate in shape with concave side toward the front. These are separated from the forehead by a bow-shaped band having alternately dark and light divisions. The under side of the head with the mouth parts are shown at B in the woodcut, and these last are exceedingly minute. All that can be clearly made out are two curved and pointed mandibles with faint traces of mouth opening, but no projecting ligula or proboscis.

The antennæ are very slender, consisting of ten joints, of which the first curves outward, with a distinct tooth on the inner side near the upper end; the second is oval, being only half the length of the others and broader; the remaining joints do not seem to be perfectly round, but rather four-sided, with points or teeth at the upper end of all except the last, which terminates in a tapering tip.

The thorax is the largest part of the body, equaling in bulk the head and abdomen together. The prothorax, mesothorax and metathorax are nearly equal in size, as may be seen by the divisions of the back which are shown in the figure.

The wings are linear, of sigmoid curvature, with three or more longitudinal lines of minute hairs on the faces, and fringed at the edge with comparatively long ones, which have a black medulla or pith in the greater part of their length, but the inner part, next the body of the wing, is so transparent as to be hardly visible, and gives to the fringe the appearance of being separated from the wing, though with high magnification the hairs can be traced through their entire length. In mounting this specimen the wings of the left side were partly torn from their place and reversed, so that the fore wing is that which is seen in the figure nearest the rear of the body, and the hind wing is that which appears to have its socket nearest the head of the insect. Their proper origin is in fact at *a*, whilst at *b*, careful examination shows a slight projection or shoulder on the fore wing where a corresponding part marked *b'* on the hind wing articulates with it when both are in proper position.

The legs are nearly as long in proportion to the body as those of the common mosquito. The tarsi are five-jointed. The tibial spurs are large and strongly developed on the fore legs, as shown at *c* and *c'* in figure, and opposite them on the first joint of the tarsus the fringe of hairs is very noticeable, which is sometimes called the "comb" in larger insects. The tibial spurs are insignificant on the other legs. The foot-pads or *pulvilli*, with the claws are so minute as to be scarcely distinguishable even under a power of four hundred diameters.

The abdomen is pediceled, and is very short and obtuse, its longitudinal diameter being rather less than its transverse. It is so opaque that the rings can only be well seen at the edge where they appear as in section, and where they have a pronounced appearance of being telescoped, the edges passing beyond each other as if the abdomen had been flattened in the direction of its length. I should have thought this an accidental condition of the present specimen, but for the fact that Prof. Packard found it the same in the one described by him. Five rings can be distinctly made out, with the probability of a sixth, and perhaps a seventh. Upon the under side of the abdomen a long spike-shaped ovipositor is seen, whose form and dimensions are shown in the second outline of the abdomen at C in the figure.

This description of the *Pteratomus*, of which all the parts have been carefully verified, corroborates collaterally the opinion of

Prof. Packard, as to its *habitat* as a probable egg-parasite upon the *Megachile* or upon another parasite of this bee, and agrees with the measurement he made of its size and the description of such parts as his probably damaged specimen enabled him to determine, except in an important particular of the wings. In the example before me I find the wings entire, not fissured. This would have induced doubts as to the species had not Prof. Packard himself seen this specimen and concurred with me as to its identity.

It is not improbable that the dissection of other leaf-cutter bees in water, might lead to the washing off and securing of other specimens of this minutest of Hymenoptera, and the beauty of the little insect itself, with its rarity, would well repay the naturalist for some pains in adding it to his collection.

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THE ROBIN'S FOOD.

BY DAVID ALEXANDER LYLE.

ON the morning of May 28th, of last year (1877), I found a robin's (*Turdus migratorius*) nest, about 27 feet from the ground, in a fir tree. It was placed on horizontal twigs near the top. The materials of this nest were the dried blades and roots of grasses. A string over four feet long was found looped around one of the limbs on which the nest was built, but no part of its length was incorporated in the structure. Notwithstanding the protestations of the old birds, I took the ugly-looking thrushlet from the nest and carried it home, with the intention of rearing it to maturity if possible. I procured a large rectangular wire cage, in which, with all due tenderness, I installed my foundling. I furnished him plentifully with stores of boiled eggs and mashed potatoes, mixed as prescribed by those paragons of female character who are self-constituted authorities upon the subject of avian cuisine. I placed conveniently for his use a bath of pure water, and also filled his water-cup. Yet, in the midst of all these delicate attentions, my baby bird steadfastly maintained an air of utter indifference. He neither ate nor drank, but sat, all drawn up on the bottom of the cage, giving vent to an occasional weak chirp. I tried to make him eat by taking little pieces of bread and hard-boiled egg in my fingers and approaching them to his bill after

the manner of the old bird, but to no purpose, his mandibles seemed to be hermetically sealed.

Finding all attempts to coax this exasperating bird to eat in vain, I concluded to forego moral suasion, and try what virtue there was in physical coercion. I opened his mandibles and put small pieces of bread, potatoes and boiled egg so far down his throat that he had to swallow them. I quenched his thirst in a similar manner by pouring a few drops of water at a time into his pharynx. This treatment revived the patient somewhat, but did not give entire satisfaction; I then began feeding him on raw beefsteak three times a day, morning, noon and night, giving him bread and egg in the intervals.

The effect was magical, his eyes brightened, his chirping became loud and vigorous, he would hop about briskly, and continually attempted to get out of the cage between the wires. I found that after eating he became very wild and would not allow my hand to approach him.

He soon learned to open his mouth to receive the food I offered, and henceforth gave no trouble in feeding. I next began to feed him with common earth worms, permitting him to eat nothing else for two or three days. He would eat until his crop could contain no more, then he would retire to his perch, draw down his neck as if suffering, close his eyes, drop his wings a little, and sit perfectly still for about fifteen or twenty minutes. At the end of that time he had digested the worms sufficiently to be ready for another meal. A strictly vermicular diet did not seem to agree well with him, it apparently acted as a laxative. I then alternated between raw beefsteak and earth worms, and found that when he could get beefsteak he would refuse the worms. It being the proper season for June beetles, and as they were easily collected in great numbers, I tried this species as a food, and learned with pleasure that he preferred them to anything else.

Forthwith I procured a wide-necked pickle bottle, and every night had a quantity collected for his daily rations. Henceforth, as long as these Coleoptera could be found in sufficient numbers, they were his sole food.

When they were given him alive he would seize them with his bill, and by vigorous shaking and pounding upon the bottom of his cage, would kill them and remove the elytra before swallowing

them. The delay necessitated by these operations made the time of feeding very long and tedious. When I put a live beetle down his throat he would swallow it, but would exhibit such evident signs of distress that I decided that this process was cruel and unnecessary. I then found that by excision of the prothorax and the removal of the elytra that the operation of feeding was much facilitated. When the beetles were treated in this manner, he would eat from eight to fifteen as fast as I could prepare them. After this he would take a few sips of water and return to his perch, lapse into silence, close his eyes and remain motionless for about fifteen minutes, when he would suddenly become very active and sprightly, hopping about the cage and chirping with much animation. I soon learned that this activity indicated that he was ready for another supply of bugs if offered to him.

From the date of his retention upon an exclusively coleopterous bill-of-fare the change was marvelous. His feathers grew rapidly, he increased in size and cheerfulness, he became more tractable and would allow himself to be petted and handled; but unless he was pressed by hunger he would not touch an earth worm. His mental faculties—if such they may be called—also developed rapidly. He would recognize me in the distance as I approached and would fly to the end of the cage nearest me, calling out in an eager excited note, and would try to get through the wires of the cage.

He seemed to know that he was about to be fed, when he saw the bottle with its store of beetles, and would scream with delight when I approached with it in my hand.

After I had given him three or four he would mount his perch and wait until I could prepare another, all the while watching the operation with evident interest. He would throw back his head and open his mandibles to their fullest extent to receive the proffered beetle from my fingers. His appetite knew no bounds. I was astonished at his voracity. Every day he consumed from forty to fifty of the large beetles commonly known as "June bugs." One morning at seven o'clock I gave him fifteen; I returned from the office at 12 o'clock, and from that time until sunset that evening I fed him all he could eat. During this time he disposed of seventy-two of the large beetles! I have no doubt if I had fed him during the morning he would have eaten a hundred!

By the second week in July the supply of "June bugs" becoming scarce, I had to seek some new edible for my charge. As cherries were abundant I fed him upon this delectable fruit; when hungry he would eat them greedily, but they did not seem to appease his appetite, and were speedily rejected when a few Coleoptera or a piece of raw steak appeared in sight. Whenever supplied with beef or his proper insect food, fruit was invariably discarded. Raw mutton and veal were next added to this bill-of-fare, he cared for neither, and the latter produced the same effect upon his digestive apparatus as did earth worms.

Diurnal and nocturnal Lepidoptera were swallowed with apparent zest, but it was impossible to procure enough of them to satisfy his hunger. Every day I had to eke out his subsistence with beef. On the 25th of July I concluded to set him free, and accordingly, after giving him a small meal of raw beef, I opened the door of his prison and let him go out. He did not go far from the house, but flew around from tree to tree and upon the roof; busying himself catching flies and what small Coleoptera he could find. He evidently made poor progress catering for himself, for about twelve o'clock he flew into the piazza, perched upon the balustrade and appeared very hungry. My wife got a piece of meat and he instantly flew to her, perching upon her shoulder as if imploring something to eat. She placed him in his cage once more, and until August 7th he was not allowed egress. From that date until August 25th he was allowed to spend every day out doors; he always returned toward evening for his beefsteak and was put back in the cage. Although other robins were in the vicinity he evinced no desire to go with them. I noticed, however, that every day he was out he became more timid and appeared to be gradually regaining his feral nature. During the early part of August I collected great numbers of grasshoppers, of which he appeared very fond. The number of Orthoptera he would devour in a day was simply astonishing. He now appeared to be fully grown.

August 25th was a damp, cloudy day, with frequent light showers. He was let out of the cage at the usual time, about eight o'clock, and was not seen again. Whether he had been frightened off to some distance and did not know the way back or whether he had concluded to trust his chances in the "wide, wide world," I never knew.

I observed that when at large and hungry, this robin would eat flies, moths, ants and worms, but never seemed to be able to obtain enough to satiate his inordinate appetite.

When I found my search for beetles so poorly rewarded, I directed my attention to observations upon the feral members of the genus *Turdus*, to learn, if possible, whether or not their exertions were more fruitful. I found that they had about as much difficulty in procuring a livelihood as I had for my feathered ward. I also noticed that they were only frugivorous when driven by hunger and the lack of an adequate supply of insects. That robins were strictly insectivorous as long as the supply was equal to the demand, and that they did not like Colorado beetles as an article of food. And, lastly, for every cherry or grape they ate, they destroyed thousands of injurious insects.

In the Armory grounds twenty-three pairs of robins were known to be nesting in one month. And since the young robin whose gastronomical feats have been narrated above, was found capable of eating seventy-two large beetles in one day, it is not unreasonable to assume that each bird would destroy at least one hundred insects per day, taking them as they come, small and large. Therefore, the forty-six birds known to feed on these grounds and vicinity, would require 4600 insects per diem, or in thirty days they would despatch the large number of 138,000 insects! This quantity at first glance may seem to be a very large estimate, but when it is remembered that each pair had a nest containing from one to four young which required food, and that have not been included in the above, it will be apparent, that it is rather an under than an over-estimate.

Taking into consideration the rapid, and in many species marvelous reproduction and increase of insect life, it will be seen that robins must exercise a considerable influence upon the entomological world, by preventing an undue increase of those species upon which they feed. When driven by hunger, and then only, in the opinion of the present writer, do these beautiful, sprightly birds attack our small fruits.

Upon a small cherry tree near my house, to which these birds had undisturbed access, only about one cherry in twenty was found to be molested. Even had the loss been greater, how small would it be in comparison to the myriads of noxious insects destroyed annually by these feathered guardians alone. Still, we

hear the crack of the gun wielded by the wanton hands of thoughtless boys and ignorant men, which announces to our ears the painful fact that another of our most useful friends has been murdered. It is none the less murder, because it is called "sport." It is to be hoped that the efforts of our naturalists will eventually be successful in rendering apparent to our law makers the necessity for more stringent protective laws with provisions for the sure and speedy punishment of the avicide.

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THE RUNNERS OF ERYTHRONIUM AMERICANUM.

BY EDWARD POTTS.

THE botanist or amateur flower collector who wanders at this season of the year (early in May) along the woodland stream or loamy hillside, can hardly fail to observe numerous colorless stems, forming, as it were, little loops three or four inches in length, on or near the ground, both ends being buried beneath the surface. If his curiosity should lead to a closer examination, he will find that while one end is firmly rooted, the *other* yields readily to his effort to withdraw it, and proves to be, not a root, as he may have at first supposed, but a stem, smooth and of uniform diameter, excepting at the end, where it enlarges into an oval knob, which, later in the season, is further developed as a true bulb, and ultimately planted by the growth force of this slender stem at the depth of three or four inches in the loose wood-mould. If he should trace the same stem backward, carefully loosening the earth to avoid breaking it, he would find that it had its origin with two or three others, in the lower extremity of a similar bulb, pear-shaped, somewhat flattened, perhaps one-half an inch long by one-quarter in thickness, to the upper end of which may still cling a single withered leaf. Should he visit the same locality a few weeks later, he will find that leaf and stems have both disappeared and that the little bulb he saw in the process of being planted by such a deft and delicate finger has thrown out a radiating group of roots from *near* the lower end and, showing no other signs of growth, has evidently settled itself to await the developments of another Springtime.

A whole year is a long time for our botanist to wait the solution of his problem as to genus and species; so we will anticipate the result of his observations next year. The April sun will hardly have begun to warm the south fronting hillsides, ere our

sleeping bulb will waken and reach up into the moist spring air a single glossy leaf, spotted or blotched all over with spaces of darker shade, which he will then recognize, or any child could tell him, is the sterile condition of his misnamed though favorite Dog Tooth Violet (*Erythronium Americanum*).

Soon after the leaf has fully developed, spreading forth its rich juices to the influence of sun and air, three or four stolons or runners, such as already described, will protrude at the lower extremity of the bulb, and, promptly turning upwards, will be seen bursting through the surface of the ground, reaching up an inch or two into the air and then in a wavering, uncertain way burying themselves again in the earth to plant the bulb that shall repeat the same process next year.

As is well known, in its single leaf condition this plant never blooms. In this *second* year of its existence, therefore, the bulb cannot have fulfilled its whole mission; if, and we admit it to be an assumption not proven, the law of nature would give to every individual at least the *chance* to reproduce itself by means of perfected seed. By the *third* year, then, we presume the bulb will have attained the strength necessary to enable it to send up two leaves and a flower stalk and become what it should have been called, a lily indeed, with its pendulous golden bell.

In the lily family, propagation by means of lateral or axillary bulbs (as a compensation, perhaps, for the frequent failure to perfect their seeds) is familiar to every one; but I cannot find that these partially aerial runners of the Erythronium, by which it projects its bulbs sometimes to the distance of a foot from the parent plant, have been previously noticed. It may be well to add that these observations refer especially to one locality in what is known as Sweet Briar Glen, Fairmount Park, Philadelphia; that the mode of propagation described, is the universal habit of the plant, the writer is not prepared to assert.

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THE MODE OF EXTRICATION OF THE AMERICAN SILK-WORM MOTH.

BY D. C. MCLAREN.

SHORTLY after reading Dr. Packard's article in the June number of the "NATURALIST," it was the writer's good fortune to observe the entire process of extrication in the case of a large and fine male specimen of Telea Polyphemus.

My attention was attracted by a rustling in my box of cocoons. The noise was traced to a cocoon which had been nearly flattened out during its previous sojourn in my coat-tail pocket, and whose development was, therefore, a surprise. I carefully cut an opening about a half an inch long, and a quarter wide on the top of the cocoon. The same method, I afterwards found, was employed by Mr. Trouvelot. I did not cut the flap entirely off, but left it so that the cocoon could be opened and closed at pleasure. All the motions of the chrysalis could be distinctly seen and studied. The back of the pupa had just begun to split. The positions of the "cocoon-cutters" were plainly marked by a pair of black protuberances on the shoulders. The end of the cocoon was *well moistened.*

The first motion was up and down. The chrysalis resting on its head and tail, arched its body so that the middle of the abdomen was thrust upwards. The object of this seemed to me to be the loosening of the moth from the pupa skin. This motion lasted about an hour, at the end of which the second motion began; this consisted of a rotatory movement. Now, for the first time, the head was pressed against the end of the cocoon. The gloss was rubbed off of the moistened portion, and the strands of silk much loosened by this boring process. Both these motions were accompanied by a slight rustling, largely due, I think, to the crackling of the cast-off larva skin.

All the preparations for exit having thus been made, the remaining steps were quickly taken. The body of the moth came to rest, its wings were drawn up from their cases by a shrugging of the shoulders, if I may use the expression, which describes the motion exactly. The shoulders were then drawn together as nearly as possible, and, while pressing against the cocoon, thrust apart with considerable violence. A tearing sound was now heard, entirely different from any which had preceded it. The cocoon-cutters, though not visible from my "coign of vantage," could be distinctly felt through the wet cocoon. Turning a little, the operation was repeated. After several repetitions, a weak spot was found, where the cutters were forced through. The small opening was quickly enlarged, the back of the thorax and the shoulders were thrust through, followed by the head, antennæ and fore-legs, in the order named. The remainder of the task was readily accomplished, and the perfect insect emerged two hours from the beginning of my observations.

I am by no means positive that the silk was actually broken by the cutters. It may have only been pushed aside. Without the aid of these little instruments, however, it is difficult to see how our moth could have forced its way through the prison walls of its own construction. It was a noticeable fact that the legs took no part in the process of extrication, but remained folded inactive on the breast. The cocoon-cutters might easily have escaped the notice of one not expecting their appearance, or, if seen, they might readily be mistaken for legs, by one who did not know of their existence.

The moth was much longer than usual in developing its wings, so that the period assigned for this extrication may be above the average.

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MOQUI FOOD-PREPARATIONS.

BY EDWIN A. BARBER.

THE *pee-kee* (piki) or Moqui bread is a thin tissuey substance of a greenish-blue color; the sheets measure about two feet by a foot and a half, and are usually folded twice, at right angles. The successive bundles or horizontal layers resemble, more than anything else, piles of blue silk of a coarse texture. This *piki* is brittle and very palatable, but a great quantity is required to satisfy one's hunger.

The flour or meal, of which the *piki* is made, is usually ground by the women. The mills consist, in almost every instance, of three stone boxes, probably a foot and a half square, and about eight inches in depth. In each compartment is a smooth stone, fitting the bottom, but inclined from the back to the front. Behind each of these mills (*metates*) a woman, by means of a long grinding stone, rubs the grain which is placed on the *metate*. The grinders are usually a foot in length, four or five inches in width and an inch or two in thickness. The corn flour, or "*ngum-ni*," as it is called, is of two qualities; the *pink* or *bluish*, and the *white*. The corn raised by these people scarcely grows to the height of two feet and the ears are short and small, the grains being either white, or red and blue, somewhat resembling that which we call here Mexican or pop-corn. The white corn is converted into a white flour, which compares favorably with our finest brands of corn meal; the red and blue corn is ground into a coarser powder, of a pinkish tint, for ordinary use. From this

latter the *piki* is generally made, although it is occasionally made of the white, and, in fact, is produced of every intermediate shade of color. In all of the houses, I noticed large quantities of corn, dried and stowed away like cord wood, or hung from the rafters in great bundles. This precaution is taken in order to prepare for a famine, as the ordinary means of subsistence of the Moquis is precarious at best. Being an industrious race, they are, as a consequence, provident, so that in time of long protracted drought their supplies of corn, dried fruits, vegetables and meats would be ample to carry them safely through the siege.

The labor of making *piki* falls to the women, and is indeed a singular process. The female, after grinding the meal, mixes it with water in a large earthen bowl, when a thin blue paste is obtained. Into this is sprinkled a small quantity of cedar ash. The baker then sits or kneels before a stone oven, with the vessel containing the batter by her side. The oven consists of a large, flat, polished stone slab, some two feet long, a foot and a half wide and three or four inches thick, placed horizontally and raised a few inches from the floor. Under this a fire is kindled, and when the stone becomes hot it is ready for use. First it is greased, and then the woman dips her hand into the substance and smears it rapidly over the entire surface of the stone in a thin layer. In a few seconds this is peeled off and placed on a corn-husk mat. When a number of these sheets have been baked, and while they are yet warm and pliable, they are folded together twice and constitute a loaf. Many of these loaves are made at one baking, and when they are finished are placed on a shelf, ready for use. I have observed one woman make as many as a dozen heaping baskets of *piki* in a short time. In eating it, pieces are broken off with the hand, as it is two brittle to cut. It has a peculiar taste, although the corn flavor is prominent, and a relish for it is soon, if not immediately, acquired. Another food preparation which is made by this interesting tribe, is a mixture or hash of dried fruits, chopped meal and *straw*, which is formed into little flat, circular cakes, four or five inches in diameter, and these are then placed on the roof to dry. This *toom-e-tóch-e-nee* (tum-i-lák-i-ni) is the most repulsive looking conglomeration conceivable.

During the summer, pumpkins and melons are cut up and dried, which, when used, are said to be pleasant to the taste.

One evening I had the opportunity of attending a Moqui repast,

having been invited by the *cacique* or governor of the town of *Gualpi*. As soon as we had ascended to the roof of the first story of the house, we were directed to be seated on robes, and forming a circle with our legs tucked under us, Turk-fashion, a huge earthen bowl of dried pumpkin soup was placed before us. Into this, each of us thrust the first two fingers of either hand, in turn, and raised it to our mouths. The second course consisted of the *piki*, which was followed by dried fruits and meats.

The manner in which corn is sometimes served is an excellent one. When in the milk, it is cut down raw and the pulp made into little cakes and rolled up in the husks. This is then either boiled or placed in the ashes to roast, but in either form it is particularly agreeable. In every house we entered, we were treated in a most hospitable manner. The Moqui bread was invariably set before us, after robes had been spread for us to sit upon.

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RECENT LITERATURE.

JORDAN'S MANUAL OF THE VERTEBRATA.[1]—This work fills a unique place in our educational and scientific literature, and our formerly published anticipation that a new edition would soon be called for, is now realized. It is simply the only book which can be used by the teacher or scholar in imparting or acquiring a knowledge of perhaps the most important branch of biology, as represented in the north-eastern quarter of the United States. It does not aim to do more than furnish a basis for the simple recognition of the species of the *Vertebrata* of this region, together with the groups of all ranks into which they naturally fall. In this effort the author is mainly successful. The definitions are concise, and generally exclude all but essential features. This is a merit not to be lightly overlooked, in view of the proneness on the part of many writers to mingle the non-essential with the essential, and to produce a prolixity very confusing to the student. Of course, where the author adopts names which do not represent things or ideas—which in some instances he does, in deference to authority, we suppose—definition is impossible. In these, and in some others where there is some practical difficulty in the observation of the true characters, definitions of a trivial nature are employed. We allude especially to such generic definitions as consist of qualities of color and size; characters which are essentially specific, and must always be so. This has been done in

[1] *Manual of the Vertebrates of the Northern United States, east of the Mississippi river and north of North Carolina and Tennessee, exclusive of Marine species.* By Prof. D. S. JORDAN. 8vo, pp. 401. Chicago. Jansen, McClurg & Co. 2d edition, 1878.

some families of the birds where the genera have been too greatly multiplied; *e. g.*, in the *Strigidæ*, *Icteridæ*, *Fringillidæ*, *Hirundinidæ*, *Corvidæ*, *Tyrannidæ*, *Ardeidæ*, *Anatidæ*, etc. As a model of really diagnostic analysis we refer to that of the *Falconidæ* (p. 110), where the divisions, whether all generic or not, receive the characters which belong to them in the system.

The most valuable part of the book is that relating to the fishes, where the ichthyologist, as well as the beginner, can obtain important information. Prof. Jordan's original work having been chiefly in this field, where he has added materially to the science, we have here the latest results as to species and genera, and their distribution. This work is, then, the only hand-book of the ichthyology of our fresh waters which we possess. A useful review of the North American species of *Salmo* is given in an appendix. This has been much needed, as the carelessness and incompetency of amateur writers has been especially displayed in the literature of this popular genus. Fifty-three nominal species are here reduced to seventeen, the reduction being greatest in the Pacific coast salmon, where Suckley wrought such confusion. We are also glad to see those myths, *Salmo confinis*, *S. symmetrica*, *S. toma* and *S. adirondacus* finally laid. We wish we could say the same for the barbarous names employed for the Pacific *Salmones*. Such names as "*gorbuscha*," "*nerka*" and "*keta*" should have a very good diagnostic basis to admit them to toleration. A similar synopsis of the species of *Coregonus* follows, These are referred to four genera, a proceeding, as appears to us. not warranted by the facts.

We recommend this work to teachers and students of North American zoölogy as a *sine qua non* in this department.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, September to December, 1877.—This number forms a volume of one hundred and seventy pages, which are occupied as follows: List of members, correspondents and officers, 48 pages; indices 18 pages; reports of officers 69 pages; short verbal communications on scientific subjects 30 pages; scientific papers 8½ pages. Of the last there are three, the conclusion of Prof. Jordan's description of the catostomoid fish, *Lagochila lacera*; description of a new *Helix*, and a valuable discussion by Mr. J. A. Ryder, of the relation existing between the structures and uses of the incisor teeth of rodents. The list of contributors of papers during the year 1877, includes twenty-two names, of whom seven are resident members of the Academy, and four of whom appear to have based their work on specimens in the museum of the Academy.

A novel feature introduced into the proceedings during the last few years, has been the "Report of the President." An annual President's address, which gives a review of the progress of science during the year, is a usual feature of the publications

of scientific bodies, but the present "Report" consists chiefly of a discussion of the financial condition of the society, a duty which is usually left to the treasurer to perform. As to its subject matter, we have to observe that little or nothing is said respecting the fostering of scientific research, in any practical way; but money is asked for, to be expended in erecting a new building, and in payment of persons to catalogue the books and to label and catalogue the specimens in the museum. No notice is taken of the comparatively inconsiderable additions to the museum during the year, as indicated by the reports, nor of the fact that the determination and labeling of the specimens has been mostly confided to persons having little or no knowledge of the necessary departments of natural science. The president remarks: "Promptly mounting, labeling, and displaying specimens in the museum as fast as presented, can no longer be safely confided to volunteer and gratuitous labor alone. There is constant occupation for two or more experts for whom a reasonable compensation is essential." There is a *naïveté* in these expressions which is surprising as coming from a president of what was once the most efficient scientific body in this country. The supposition that specimens in any department of natural science which has not been thoroughly exhausted, can be "promptly mounted, labeled and displayed," could scarcely be entertained by the humblest student of science; and the expectation that even "experts" would pursue scientific research for the purpose of "displaying specimens in the museum as soon as presented," shows that the president of the academy is in a state of lamentable ignorance as to the real object of its existence. The idea that it is a show museum, appears to have entirely excluded the true view of its founders, and of all of the scientists who have built it up, viz: that it is an institution of original research. With this fact in view one can understand how the "volunteer and gratuitous labor" of its scientific members cannot be "safely confided" in, and how the places of such members have been supplied by employés who make no pretensions to scientific knowledge or reputation.

It also explains how the only moneys available for the payment of salaries, have been devoted to the employment of such persons, while tens, nay, fifties of promising young students or mature men of science throughout the country, who are struggling with poverty, would consider such positions as placing within their reach the realization of their highest aspirations.

In view of these facts the President's remarks on the subject of Professorships (p. 324) impress us as inconsistent. He is primarily in error in stating that one of the objects of such an officer would be to give "systematic courses of instruction," if by this, complete courses such as are required by our schools, is meant. The object had in view by the proposers of this part of the organ-

ization was simply to offer to those meritorious scientists who were performing volunteer labor in connection with the Institution, positions which would enable them, each in his department, to develop his science, and at the same time the collections and publications of the Academy. Endowment, while very desirable, was not regarded as more indispensable now than in the past, which had been adorned by numerous able volunteer laborers. The fact that the expenses a little exceed the receipts in the case of the single gentleman appointed to a professorship, does not demonstrate, as the President thinks, that the scheme as adopted two years ago, cannot be realized; for his conclusion is at least forgetful of the gentlemen who subscribed the small deficit.

To the latter class, the liberal citizens on whom progress so much depends, we would say:—that if the Academy is to occupy the position as a means of development of the natural sciences which she ought to hold, it will not be by the adoption of the policy maintained in this report. The results of that policy, as seen in the collections and publications of the Academy, are sufficiently well known. Endowment of original research does not mean creation and maintainance of show museums, or the building of fine houses. It can only be accomplished by putting right men in their right places, and furnishing them with the means of making the requisite collections, researches and publications. And in order that these means be expended in profitable directions, scientific institutions must be officered by scientific men. To pay salaries to unscientific men to do scientific work, or to pay for the publication of such reports as go to make up the bulk of the volume before us, is, in our estimation, a diversion of money from its proper object.

THE ANCIENT LIFE HISTORY OF THE EARTH, BY DR. NICHOLSON.—[1] This book is, as stated by its author, primarily intended for the student, but the style has been adapted as far as possible, to the wants of the general reader also. While the former object is quite attainable in a work like the present, the latter is more difficult of accomplishment. Popular palæontology implies a greater knowledge of zoölogy than the general reader usually possesses, and the subject can only be rendered intelligible by a greater amount of zoölogical analysis or statement, than we find in the present work. The excellent illustrations given by Dr. Nicholson do a great deal towards rendering the names in the text comprehensible to the reader of this class. The general remarks, both preparatory and final, are sound, and the references to the literature of the subject extend the opportunities of the student beyond the field to which the work is necessarily confined. We only notice two faults, viz: the omission of the strati-

[1] *A comprehensive outline of the principles and leading facts of Palæontological Science.* By H. ALLYNE NICHOLSON, Prof. Nat. Hist. Univ., St. Andrews. D. Appleton & Co. 8vo. pp. 408.

graphy of the interior of the North American continent; and the adoption of some of the pseudonyms of American vertebrate fossils, which have latterly become current in some quarters. Such are *Dinoceras* and *Brontotherium*, which it is well known in this country have never been distinguished as genera from the old *Uintatherium* and *Menodus*.

MATERIAL FOR A BIBLIOGRAPHY OF NORTH AMERICAN MAMMALS.[1]—This work covers 132 pages of closely printed quarto of the series of final reports of the Hayden Survey. It includes references, by page and date, to all works and papers, large and small, which relate to the *Mammalia* of North America, both recent and extinct. Such a work as this, if well prepared, must be, it is easily perceived, most invaluable to the student in this extensive department, as well as to all persons desiring access to any part of it. After a critical examination of its contents we can say that it fully justifies the reputation of its authors for fullness of research and accuracy of statement. Its arrangement is well calculated to meet the needs of the student. The first division includes general works; the second, those on faunæ and distribution. Then follow the orders of the class, each constituting a division; and papers received or discovered during the compilation of the preceding part of the work, complete it. In the case of extinct *vertebrata*, lists of species described in the respective papers are given, which is an obvious convenience; while the arrangement is chronological. The date of publication is usually given to the day, but a few omissions in this regard are noticeable. We recommend this work as an index to the subject of Mammalogy, which no student can be without.

KING'S GEOLOGICAL EXPLORATIONS OF THE FORTIETH PARALLEL.—The second and fourth volumes, and atlas of geological maps of this important Survey, have lately appeared from the office of the United States Engineers, War Department. 1877. Volume ii. is entitled Descriptive Geology, by Arnold Hague and S. F. Emmons. It is illustrated by twenty-six photographs of the more remarkable scenery along the Union and Central Pacific Railroads, from Wyoming and Colorado to the Sierra Nevada, and is of particular value as giving a detailed description of the geology of a region often visited by travelers and scientists, while the work will eventually prove of great economic importance.

The fourth volume contains, Part i., Palæontology, by F. B. Meek; Part ii., Palæontology, by James Hall and R. P. Whitfield; Part iii., Ornithology, by Robert Ridgway. We have noticed the latter work elsewhere. The posthumous work of Mr. Meek is illustrated by seventeen plates, representing fossils from the

[1] *Appendix B of the Monographs of the North American Rodentia*, by Dr. COUES and Mr. ALLEN, or vol. ix. final Report U. S. Geol. Survey Terrs. under Dr. F. V. HAYDEN. By Prof. THEODORE GILL and DR. ELLIOTT COUES.

Silurian to the Tertiary; while the portion by Messrs. Hall and Whitfield refer to Palæozoic, Triassic and Jurassic fossils, and is illustrated by seven plates. The atlas of maps is of great beauty and value, and worthy of this famous Survey.

United States Fish Commission.—The report for 1875–76 of Prof. Baird, U. S. Commissioner of Fish and Fisheries, forms a bulky volume of over a thousand pages, and is, like the preceding ones, of great practical value. Besides the report of the Commissioner is an appendix containing a valuable history of the American whale fishery from its earliest inception to the year 1876, by Alexander Starbuck, comprising 768 pages; E. W. Nelson reports on the fisheries of Chicago and vicinity; Livingston Stone on the salmon fisheries of the Columbia river; Dr. C. C. Abbot on some fishes of the Delaware river; R. Hessel on the carp and its culture, and its introduction into America; J. W. Milner reports on the propagation and distribution of shad; C. E. Atkins on the collection of eggs of Schoodic salmon in 1875 and 1876; and Livingston Stone finally states the results of operations on the M'Cloud river in salmon breeding in 1875 and 1876.

Leuckart's Human Parasites.[1]—We feel sure that we shall do some one a favor, even at this late hour, in calling attention to this valuable and exhaustive work on parasitic worms. It is the most recent and trustworthy work the physician can obtain, and it is to be hoped that an English translation will soon appear, though Cobbold's Entozoa is most excellent in its way, and the best English work on the subject.

Recent Researches on the Nervous System of the Hydrozoa.[2]—The work before us is one of the most important contributions to our knowledge of the nervous system of the pelagic Medusæ that has ever appeared. The investigations were principally confined to the *Geryonidæ*, *Trachynemidæ*, *Æginidæ* and *Æquoridæ*. The conclusions which the authors arrive at are of the highest significance in relation to the question of the origin of the nervous system and sense organs in the higher forms. They find here, as Schulze has proved in the case of the higher animals, that the terminal elements of the sense organs—touch, hearing, etc., are of epithelial origin, and also that the ganglionic and intermediary fibrillar system is of ectodermal origin; further, that the termini of the motor nerve system were likewise primarily epithelial and at first formed part of the ectodermal covering of the animal.

The delicacy of the tissues that these investigators have had to deal with renders their manipulation difficult, but the results at-

[1] *Die Menschlichen Parasiten und die von ihnen herrührenden Krankheiten. Ein Hand und Lehrbuch für Naturforscher und Aertze.* Von Prof. Rudolf Leuckart. 2 Bande. Leipzig und Heidelberg, 1863–1876. 8vo, pp. 766, 882. With numerous woodcuts.

[2] *Das Nervensystem und die Sinnesorgane der Medusen Monographisch dargestellt.* Von Oscar und Richard Hertwig. 4to. pp. 186. Taf. 10. Leipzig, 1878.

tained are best appreciated by reference to their very excellent plates, where the relations spoken of can be readily seen. The resemblance of the peripheral sensory cells to the analogous organs in the vertebrates is very striking, and shows in a most forcible manner that organs which subserve similar purposes, even in widely separated classes of animals, are developed in very similar ways and into very similar forms. The fact of their epidermal and ectodermal origin is rich in its bearings upon an explanation of the development of the nervous system of the vertebrates, where as here the organs of percipient relation are of ectodermal origin, with the super-addition of a highly developed psychic ganglion, the brain, which, no matter what may be the argument to the contrary, can boast a no more aristocratic parentage than the rest of the nervous system.

Recent Books and Pamphlets.—Annual Report of the Entomological Society of Ontario, for the year 1877. By W. Saunders, Rev. C. J. S. Bethune, B. Gott and J. Williams. Toronto, 1877. 8vo, pp. 59.

Bulletin of the U. S. National Museum, No. 10. Contributions to North American Ichthyology, based primarily on the collections of the U. S. National Museum. II. By D. S. Jordan, Washington, 1877. 8vo, pp. 120. 45 plates.

On the Superficial Geology of British Columbia. By G. M. Dawson. (From the Quarterly Journal of the Geological Society of London. Feb., 1878.) 8vo.

Notes on the Oceanic Copepoda. (Extracted from the Appendix to Capt. Nares' forthcoming Arctic Voyage.) 8vo, pp. 5. Ten Days Dredging at Oban. (Extracted from the Quarterly Journal of Conchology. Nov., 1877.) 8vo, pp. 4. On the new British Nudibranchiate-Mollusca. (From the Annals and Magazine of Natural History for Dec., 1877.) 8vo, pp. 3. Note on Telaginopsis (Polycerias Hincksii); and on the Circumpolar Distribution of certain Hydrozoa. (From the Annals and Magazine of Natural History for March, 1877.) 8vo, pp. 4. By Rev. A. M. Norman, M. A.

Bulletin of the University of California, No. 32. On the Destruction of the Ground Squirrel by the use of Bi-sulphid of Carbon. April, 1878. By E. W. Hilgard. 8vo. pp. 6.

Bulletin of the University of California, No. 31. The Rainfall in California, its Distribution, its Periodicity, and its Probabilities. Feb., 1878. By G. F. Becker, B.A., Ph.D. 8vo, pp. 10, with diagrams.

On the Genus Actinometra Müll., with a Morphological Account of a new Species (*A. polymorpha*) from the Philippine Islands. By P. Herbert Carpenter, B.A. (Extracted from the Linnean Society's Journal. Zoology, Vol. xiii.) 8vo. pp. 17.

Die Kometenform der Seesterne und der Generationswechsel der Echinodermen. Von Ernst Haeckel. (Abdruck aus der Zeitschrift für wissenschaftl. Zoologie; xxx, Bd. Suppl.) 8vo, pp. 25. With a Plate.

On some Points in the Anatomy of Pentacrinus and Rhizocrinus. By P. Herbert Carpenter, B.A. (From the Journal of Anatomy and Physiology, Vol. xii.) 8vo. pp. 18.

Die Bewegungen der fliegenden Fische durch die Luft. Von Karl Möbius. 8vo. pp. 40. With a Plate.

Notes on the Petrography of Quincy and Rockport. By M. E. Wadsworth. (From the Proceedings of the Boston Society of Natural History, Vol. xix. Feb., 1878.) 8vo, pp. 8.

Ueber die Schmuckfarben der Daphnoiden. Von August Weismann. (Separatabdruck aus Zeitschr f. Wissenschaftl. Zoologie, xxx, Suppl. 1.) 8vo, pp. 43. With a Plate.

Description of new Genera and Species of Isopoda, from New England and adjacent regions. By Oscar Harger. Brief Contributions to Zoology from the Museum

of Yale College. (From the American Journal of Science and Arts, Vol. xv. May, 1878.) 8vo, pp. 7.

Manual of the Vertebrates of the Northern United States, including the district east of the Mississippi and north of North Carolina and Tennessee, exclusive of Marine Species. By David S. Jordan, Ph.D., M.D. Second Edition, revised and enlarged. 8vo, pp. 407. Chicago: Jansen, McClurg & Co. 1878.

Memoirs of the Geological Survey of India. Palæontologica Indica. Indian Tertiary and Post-Tertiary Vertebrata. Vol. i, 3. Ser. x, 3. Crania of Ruminants. By R. Lydekker, B.A., of the Geological Survey of India. 4to, pp. 84, with Pls. I–XXVIII. Calcutta, Government Press, 1878.

Die Kometenform der Seesterne und der Generationswechsel der Echinodermen. Von Ernst Haeckel. (Abdruck aus der Zeitschrift für Wissenschaftliche Zoologie. XXX. Band. Suppl.) Mit Tafel XX. 8vo, pp. 424–425. 1878. From the Author.

On Argillornis longipennis, from the Eocene Clay of Sheppey. By Prof. Owen, C. B., F.R.S., etc. (Abstracted from the Quar. Journ. of the Geolog. Society for February, 1878. Vol. xxxiv.) 8vo, pp. 124–130. With Pl. VI. From the author.

Some Microscopical Observations of the Phonograph record. By Persifor Frazer, Jr., A.M. Also, Some Tables for the Interconversion of Metric and English Units, by the same author. (Both read before the American Philosophical Society, April 5th, 1878.) 8vo, pp. 531–538, with a table. From the author.

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Structure Geologique du Massif du Simplon apropos du Tunnel Projeté, par E. Renevier. (From the Bulletin de Société Vaudoise des Sciences Naturelles. Vol. xv, No. 79.) Lausanne, Librarie Rouge et Dubois, 1878. 8vo. pp. 281–304. (Plates 20–21.) From the author.

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A List of the Species of the Tribe Aphidini, Family Aphidæ, found in the United States, which have been heretofore named, with descriptions of some new species. By Cyrus Thomas, Ph.D. (Ext. Bull. No. 2, Ill. State Lab. of Nat. Hist.) Printed Dec. 13, 1877. 8vo, pp. 16. From the author.

Notes on the Natural History of Fort Macon, N. C., and vicinity. (No. 4.) By Dr. Elliott Coues and Dr. H. C. Yarrow. (Ext. Proc. Acad. Nat. Sci., Phila., 1878.) 8vo, pp. 21–28. From the authors.

The Electric Constitution of our Solar System. By Jacob Ennis. (From the Proceedings of the Academy of Natural Sciences, Phila., 1878.) 8vo, pp. 19. From the author.

On the identity of certain supposed species of Sigillaria with Sigillaria lepidodendrifolia Brogniart. By Herman L. Fairchild. (From the Annals of the New York Academy of Sciences. Vol. i, No. 5.) 8vo. pp. 129–133, with a plate. From the author.

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GENERAL NOTES.

BOTANY.

The Mycological Flora of Minnesota.—Dr. A. E. Johnson contributes to the Bulletin of the Minnesota Academy of Natural Sciences, an essay of a hundred pages on the fungi of that State. He has collected and determined 559 species all new to the State, two of which are new to science, and the report is the result of the examination of more than ten thousand specimens. The essay is mainly an enumeration of the species, and must prove of much assistance to local botanists, and though we are unable to pass a critical judgment on the quality of the work, it evidently reflects credit on the Society and State from which it emanates.

Ligneous Flora of Iowa.—In a page reprinted from the *Valley Naturalist*, Prof. J. E. Todd gives a list of the trees and woody shrubs and vines of South-western Iowa, a region varying in altitude from about 1000 to 1300 feet above the sea, the prevailing soil being that of the loess.

On the Growth of Cocculus Indicus.—I have noticed that the termini of the branches on a plant of *Cocculus indicus*, in the Horticultural Building in Fairmount Park, were coiled to the left about objects that came within reach. These terminal coils, which

simulated tendrils in form, would, if straightened out, measure 6 to 8 inches inches in length. The buds upon them appeared to be aborted or rudimentary, and as soon as the coil was securely wound round its object of support, growth in a longitudinal direction in the branch in question seemed to cease; but below the proximal part of the coil, or that nearest the root, one of the fully developed buds would break and continue the ascending axis, which, when it had attained a length of 1 or 2 feet, would coil its terminus, and stop growing lengthwise as the branch had done from which it grew. This process seemed to be repeated indefinitely. The plant might be called a *terminal twiner*. Other menispermaceous plants seemed to have a similar tendency, though not so marked, and some were not very different in habit from ordinary twiners, as, for examples, *Menispermum canadense*. *Aristolochia*, it has *since* been discovered, exhibits in a slight degree a similar tendency.—*Jno. A. Ryder.*

Botanical News.—Francis Wolle concludes (*Bulletin* of the Torrey Botanical Club, April) that *Nostoc*, which has generally been considered a perfect plant, is not so, but the "matrix" of *Scytonema*, from which many forms of the latter genus are evolved. The paper is illustrated by a full page cut. In the *Botanical Gazette* Charles Mohr notices the foreign plants introduced into the Gulf States. Mr. R. Burgess records a case of natural radical grafting, "potting two plants of the deer's tongue and rat-tail Cactus, resulting in a profuse crop of the latter issuing from the extremity of the leaves of the former."

Trimen's *Journal of Botany* contains a notice of Rodier's second note on the spontaneous and regular movements of *Ceratophyllum demersum*. In general when examined at about six in the morning, a movement of torsion from left to right is proceeding; this then stops and gives place to a movement from right to left, which continues up to about 11 A. M., that is for about five hours; the experiments showed a mean of about 36° per hour, *i. e.*, of 180° or half the circumference during the whole time. The reverse torsion from left to right commences immediately the former ceases and goes on at the rate of about 12° an hour—one-third that of the morning; estimating its duration at 7½ hours, its amount is 90°, or one-half that of the morning. Tables are given of these results, and show that there is by no means complete regularity in the movements.

M. Rodier's observations were stopped in November by the plant passing into its winter state, in which its movements are almost entirely suspended. The elongation of the terminal buds ceases, the last verticils of leaves remain closely imbricated, and the latter become stiffly curved, thicker, and larger, with the air-cavities swollen and full of gas, at the same time the axis becomes thickened and pink and its cells are found to be crowded with starch and rounded. In short, we have here produced winter

buds by which the plant is propagated. They are very easily detached from the old stems, and then readily float, and are carried by stream.

S. E. Cassino, Salem, Mass., announces the publication, June 10th, of Ferns in their Homes and Ours, by John Robinson, to be illustrated with eight chromo-lithographs of rare ferns with other illustrations.

ZOÖLOGY.[1]

CHANGE BY ARTIFICIAL MEANS OF A LAND TO AN AQUATIC SALAMANDER.—Some very interesting experiments have recently been made by Madame von Chauvin, regarding the change, by artificial means, in the Alpine salamander of a land to an aquatic life. From a translation of the paper in *Nature*, we take the following account, often word for word. The former success of Madame von Chauvin in inducing the development of *Amblystoma* from the Mexican axolotl by gradually accustoming it to live in air, induced her to attempt to change the habits of *Salamandra atra*. This is an ovo-vipiparous species, and although its young possess large gills while within the body of the mother, they are born to begin a land-life immediately, while *Salamandra maculata* brings forth its young with gills, and they live for some time in water before taking to land. The problem to be solved was whether the young of the black salamander, taken from the mother before the normal time of birth, and placed in water under favorable conditions, could become adapted to an aquatic life. Out of twenty-three larvæ of the Alpine salamander (*S. atra*) one, unlike the rest, appeared at ease when placed in water and made no attempt to get out of it, and was fed regularly. The gills, too delicate and thin for life in the water even, dropped off by the third day, but soon a second smaller set of gill-fringes grew out, which appeared to perform the work of respiration perfectly; the creature remained completely beneath the surface of the water, without ever coming up to breathe air. While the new gills were being developed the larva remained at rest as if dead, only eating the earthworms when they were offered. When the gills had attained a length of 2.2 mm., the larva became lively, and concurrent with this was the completion of another transformation. The delicate and transparent swimming membrane of the tail was lost, and replaced by a less transparent and stouter one, of greater dimensions. Finally, after six weeks' residence in the water, the skin began to be shed. Fourteen weeks after having been placed in the water, when six centimetres long, the gills began to shrink, and the tail to assume a rounder form, and in three days the skin was shed, revealing the normal black and wrinkled skin of the land salamander. At last it crawled out of the water, and on the

[1] The departments of Ornithology and Mammalogy are conducted by DR. ELLIOTT COUES, U. S. A.

fourteenth day the gills were completely absorbed and the gill-clefts absorbed. The remaining larger larvæ of this experiment lost their primary gills less satisfactorily and in a greater length of time. New gills began to bud, but the animals were gradually destroyed by fungus-growths attacking various parts of their skin. The fact that they were altogether more advanced in their metamorphosis rendered them unable to adapt themselves quickly to their new conditions. Similar experiments were less successful the next year, none adapting themselves to an aquatic life. It was thought from these experiments that the spotted and Alpine salamanders were at no very distant period of time one species, and that as physical conditions became changed one variety became more and more adapted to more elevated and rocky regions, where water for the early life of the larvæ was not commonly to be met with. Thus gradually the birth of the young was postponed, and they became terrestrial; concurrently fewer and fewer of the many eggs were developed. The spotted salamander, meanwhile, became more and more specialized to inhabit the lowland district. The bearings of these facts on evolution are of much pertinence.

RIDGWAY'S ORNITHOLOGY OF THE FORTIETH PARALLEL.—The ornithology, by Mr. R. Ridgway, of the route explored by the U. S. Geological Explorations of the Fortieth Parallel, Clarence King in charge, has been lately published. The region investigated lies between Sacramento, Cal., and Salt Lake City, and the work is based on field work from June, 1867, to August, 1869, inclusive; 769 skins and 753 nests and eggs having been collected. This is in fact a work on the avifauna of the Great Basin, and the subject is discussed under four subdivisions: arboreal, terrestrial, mural and aquatic avifauna. Although the Great Basin forms a "natural province of the western region," Mr. Ridgway states that the Sierra Nevada and main Rocky Mountain Range form "much less of an actual barrier to the distributions of the species than might be supposed," and he thinks that the deserts check the distribution of the species. The author shows that Western birds "have a tendency to extend eastward during their fall migrations, thus spreading over the whole of the Western Region at this season, though in summer their habitat may be confined strictly to the area of Pacific coast drainage." He also discovered that several species supposed to be peculiarly eastern, really inhabit the entire breadth of the continent. The work is a store-house of novel discoveries regarding the distribution and habits of the birds of the Central Province of the United States, and of a high degree of interest and value at this time, though tardily published by Government. It forms Part III. Ornithology, of vol. iv. of King's Geological Explorations of the Fortieth Parallel, lately (1877) issued by the War Department.

A Two-headed Snake.—On page 264 of your journal for April I notice an account of a two-headed snake—*Pityophis sp.*, and as I have recently discovered one in the reserve series of reptiles of the National Museum of the Smithsonian Institution, I venture to forward a description trusting it may possess some little interest to your readers.

This specimen, No. 7276 Smith. Coll., was presented by Miss Marshall, of Port Tobacco, Md., and is the specimen known as *Ophibolus getulus* (*Linn.*) Cope, the common chain or king snake. It has two perfect heads, both possessing the scale formula which characterize the species. The length of the specimen from the extremity of the right head to the end of the tail is 9 7-10 inches, length from extremity of left head to tip of tail 10 inches, by which it will be seen that a slight difference exists. The left head and neck and continuation although somewhat smaller than the right, appears to be the snake proper, the right a sort of graft on the main trunk. The two heads are 11-16 of an inch apart and ½ an inch from the end of each nose a fold of skin commences on the inner side of each neck, this being on a level with the commissure of the mouth. The color of the two white rings on each head posterior to the occipital plates, which are normal, are produced across this fold of skin, and a second white ring on the left head also passes down to the fold. This extends backwards 5-16ths of an inch from its anterior border and then the two spinal columns are welded together. The two œsophagi terminate in a common one a little posterior to the line of union. In all other respects the specimen is a typical *O. getulus*. The scutellæ below and behind the fold of skin run directly across both necks and bodies, no median line separating them, but become normal a little posterior to the juncture of the heads. When the two heads are compressed laterally together, the left one is found to be slightly longer than the right, which is a trifle larger. There are two white rings on each neck, the posterior one on the right a little behind the corresponding one on the left. This is the only two-headed snake in the enormously large collection of reptiles in the Smithsonian Institution, which I have lately gone over.—*H. C. Yarrow, Smithsonian Institution, Washington, D. C., April* 3, 1878.

Notes on Three Rare Birds of Minnesota.—Within the last few years ornithologists in and about Minneapolis, Minnesota, have found three species of birds conceded to be among the least familiar forms of our American feathered population.

One of these is the Bohemian Chatterer, or Northern Waxwing (*Ampelis garrulus*). For the past five years at least, this bird has been a regular winter resident here, arriving early in December and taking its departure in March. It is rarely observed except in large flocks, which are almost incessantly astir.

The food of the species in this latitude consists for the most part of berries, especially the fruit of the well-known snowberry bush, although it is frequently seen feeding upon bread crumbs, apple-parings and similar kinds of kitchen refuse. It is also remarked in early spring to regale itself on certain coleopterous insects which then begin to show themselves, capturing them on the wing somewhat after the manner of the true fly-catchers.

Few birds carry themselves more fearlessly among the scenes of civilization than this one, notwithstanding that its career is mainly recluse. In Minneapolis it frequently appears in the gardens and dooryards even in the very heart of the town; and with the marked beauty of its plumage and briskness of its ways, receives no little complimentary notice.

Occasionally one finds this bird caged in Minnesota, as in our severe winter weather it is readily taken in a common quail trap baited with apple. The species is, however, but poorly adapted to a life of captivity, as while it partakes regularly enough of food under these circumstances, loss of exercise ere long impairs its assimilative powers, and it succumbs to fatal emaciation. Although christened *garrulus*, the title seems a great misnomer as applied to this species, or at all events as it occurs in Minnesota; for while the species is known to very many observers hereabouts, few of these have any knowledge of its note.

My next note is on the evening grosbeak (*Hesperiphona vespertina*). Like the preceding this straggler has for the last half decade taken up his winter quarters in Minneapolis and its vicinity with almost unbroken regularity.

This also proves to be a gregarious species, seldom being seen save in troops, sometimes comprising several scores of individuals. Its usual haunts hereabouts are groves of sugar maple, the buds of which, together with the kernels of the seed of the box-elder, constitute almost its only food. It is observed with us to be even less suspicious of man than the chatterer; as it unhesitatingly establishes itself in the town shade trees, and on rare occasions, as if from motives of pure curiosity, it is seen to ramble over the housetop and up and down the porch after the manner of the wren. From its strangely ejaculatory as well as harshly piping quality, the song of the species can scarcely be compared with bird-music as one commonly understands the term. Yet notwithstanding its demerits, much of the bird's leisure time is spent in its practice both as a soloist and chorister.

The collector adds to his store the skins of the fully developed males of this Grosbeak with signal satisfaction; as from the sharply contrasted disposition of their leading hues—white, yellow and black—it is questionable whether the uniform of any of our native birds is on the whole more striking. In looking over the skins of the females taken hereabouts, they mostly disclose a

whitish edging on the inner webs of the tail feathers to which the standard authorities fail to refer.

The third bird on my list is LeConte's bunting (*Coturniculus Leconteii*). The discovery that this little known species is to be included among the birds of Minneapolis is the latest ornithological novelty of which the district can boast; being first indisputably noted only during the past summer. But his presence is still far from being a familiar one in this part of our territory, as up to date he has rigidly confined himself to one particular spot. This is a large tract of meadow just outside the city limits, which, despite the close proximity of a railroad and several other scarcely less noisy highways, proves to be a great resort for many birds, among them the species in question. It has been observed on sundry occasions during the last season, and taken both in juvenile and adult stages.

One of the smallest of the sparrows, and likewise one of the least noticeable in point of attire, it is also the fate of this species to lead a career of the utmost unobtrusiveness and humility; being for the most of his time buried deeply in the grass, where he gleans the lesser grubs and more delicate seeds found to constitute his fare. In his style of flight, as well as in his song, he is almost undistinguishable from his yellow-winged brother sparrow (*Coturniculus passerinus*); in short, it may be described as the yellow-winged sparrow transferred to low grounds and marked by certain constant characteristics brought about by the change.

While the young of the bird were procured in several instances in the meadow to which I have alluded, the nest remained undetected, doubtless being hidden so securely in the grass that its whereabouts could only have been brought to light by the luckiest chance.—*W. L. Tiffany, Minneapolis, Minn.*[1]

Mode of Distribution of Fresh-water Mussels.—On April 17, 1877, the writer, while exploring that portion of the Erie Canal known as the Wide Water, near Mohawk, N. Y., unexpectedly came across *Unio rubiginosus* Lea. Five specimens in all were secured during this and two succeeding expeditions. The species has not hitherto been found on the Atlantic slope, but belongs to the Ohio basin, and, hence, to the western fauna. It has been recorded at Buffalo (*teste* Prof. C. Dewey), and at Rochester (*teste* C. T. Robinson) in Western New York, but only in streams flowing into the great Lakes. Between Mohawk and the latter localities is a ridge or water-shed sloping to the West and the East. The Erie canal passes over this ridge, and through it the species has probably been introduced and colonized. My friend, Dr. Lewis, of Mohawk, informs me that about eight years ago he found in the canal, a single specimen of *Unio gibbosus*

[1] The nest and eggs of *C. Leconteï* are unknown, and Mr. Tiffany would do well to make thorough search for them on the spot where the species thus unexpectedly proves to be abundant.—*E. C.*

Barnes. Through the same medium other western species may be introduced.

Unio pressus Lea, was also found by the writer, near the same locality (within three miles) in May, 1877, but under conditions that preclude the possibility of its introduction in a like manner. Two specimens were taken from a small lake near Herkimer, N. Y. The lake lies between high hills and receives as its water-supply an artificial branch of West Canada Creek, a mountain stream having no connection with the Erie canal, or any stream that could possibly reach it from the west or south. It empties into the Mohawk, but over a very rocky bed, and after a considerable fall. The species is essentially western, but is recorded at Troy, N. Y. (Vide Lewis in Bulletin Buf. Soc. Nat. Sci. Aug. 1874, p. 127). Its occurrence in the latter locality may be explained, perhaps, in a manner similar to the preceding, though at no known intermediate localities has it been found. The problem to be solved is: How came this western species in this isolated eastern lake? Mr. Darwin, (in "Origin of Species," p. 344, Ed. 1877) has conjectured a probable mode of distribution, relating particularly to certain fresh-water univalves. What Mr. Darwin conjectured the writer has actually seen. The same may occur with bivalves, and certainly does. Mr. Arthur F. Gray, of Danversport, Mass., has informed me of the foot of a water-fowl, now in his possession, to which is attached a bivalve shell, the former caught and firmly held by the latter.

The young of Uniones, since they are capable of swimming freely about, may be distributed in the manner suggested by Mr. Darwin; viz: attaching themselves to pond-weeds, the latter being often carried away by water-fowl. That *Limnæa* and *Planorbis* do thus attach themselves every collector knows. Whatever the manner or cause of its introduction *Unio pressus* is found in the above lake, absolutely foreign to any *stream* through which the species might have been introduced. This species, as well as the preceding, may yet become colonized in the Mohawk River. The fact of its occurrence now and its probable recent introduction in the locality mentioned, under conditions that seem physically impossible, may be of interest when the geographical distribution of the Unionidæ comes to be more fully studied.—*R. Ellsworth Call.*

Defensive Urination of the Frog.—On the Iowa prairies, often a mile from any water, one frequently meets with frogs which leap out of the way in a very startled manner. Generally, as the first leap is made, the frog ejects a quantity of water, which falls in a mass to the amount of a fluid ounce or more, with a largely diminished quantity the second time he springs from the ground. The idea which naturally occurs to the observer, is, that this water is the ordinary urine of the reptile, voided in this

manner in consequence of the muscular action occasioned by his sudden fright. But I once saw a common garter or striped snake spring suddenly after a frog in an attempt to seize him. These snakes are reasonably active when they proceed in the ordinary style; but when they are attempting to seize their prey their motions are so quick that the eye must be very intent to follow them. In this case the frog was just a hair's breadth of time too quick for the snake, making a high and vigorous leap forward. As he sprang the usual evacuation of water fell from him, striking the snake fairly on the head, and most probably filling its open mouth. One or two more leaps in instantaneous succession carried the frog out of danger, and he was not made a meal of. But the snake was evidently blinded by the urinary discharge, for he wriggled and twisted, sprang wildly around from side to side, and was completely thrown off the track of his game. My sympathies were with the frog, and I thought in regard to that obfuscated snake, "served him right." The incident was, of course, an amusing one, and thinking of it afterwards, it occurred to me that this habit of the frog might very properly be classed as a defensive one. The snake is its usual, most frequent and most relentless enemy. Having glided noiselessly through the grass it finally makes a spring for its victim in precisely such a way as to be enveloped in this discharge, should it fail to seize the frog. The snake has no "winkers" to its eyes, and of course cannot quickly correct the blinding effect which even pure water suddenly dashed upon its head would necessarily produce. The light must be variously refracted, and images falling upon the retina very badly mixed up and distorted. In the "noise and confusion" thus arising, the frog makes good his escape. While the secretion and discharge of the urine is an ordinary physiological process, its use in this manner may be none the less a means of defense The force of the ejection, doubled by the action of the snake in nimbly darting from the opposite direction, the amount ejected and the circumstances attending the act, all seem to justify the inference that this, aside from concealment in the green herbage, is about the sole means of defense provided —"developed"—by nature to aid the harmless and inoffensive frog in evading the clutch of its alert and nimble enemy.—*Chas. Aldrich, Webster City, Iowa.*

Remarks upon Albinism in several of our Birds.—During the autumn of 1876, I saw a pet crow (*Corvus americanus*) bearing rather strange markings of a grayish color over the rump, sides and abdomen, as well as about one-half of the tail feathers. Upon the approach of winter the bird accidentally had the tail pulled out; when about two months later, it was replaced by feathers of a pale gray tint. During the coming moulting season, the parts which had previously been of a grayish color, now became white, and in addition several quills in both wings. I

became the possessor of the specimen and kept it for several months, when the bird grew sick and died. The disease affected the skin and feathers to such an extent that it was unfit for preparation; although the specimen was for some time a matter of public curiosity. An instance of total albinism occurred some years ago in Lehigh County, Penna., where the bird was kept for a number of years as a bar-room pet. Another example occurred during the winter of 1873-74, in Montgomery County, Penn., where the specimen was secured while a hunting party happened upon a rookery during the night. A great many birds were shot and amongst them the albino.

Several instances of total and partial albinism in *Turdus migratorius*, have come under my observation in Pennsylvania. In several of the supposed cases of total albinism, a pale yellowish tint could be discovered upon the tips of the feathers over the breast and sides, which was replaced upon the back by a slight grayish or ashy shade; although at a short distance they appeared perfectly white.

A female *Hirundo horreorum* was secured in the summer of 1875, near Reading, Penna., which had patches of white upon either side, extending upwards and forwards to the base of the wing. The left wing also contained several white secondaries.

From the spring of 1874, to the summer of 1877, four different specimens of *Passer domesticus* have come under my observation which were partly white. The markings were irregular and included parts of the wings, rump and abdomen, or as in one instance, the tail feathers. One specimen of total albinism was seen in the streets of Reading for several months, when all of a sudden it disappeared from its usual haunts, no doubt being secured by a collector for the adornment of his cabinet.

There is at present in a collection in Reading, an example of a nearly white *Buteo borealis*. The only defect consists of pale yellowish brown transverse markings near the tip of the tail feathers. There are visible upon close examination, delicate ashy tinted median lines in the feathers of the head, neck and back. In all other respects the bird is certainly interesting.

Partial albinism in *Agelaius phœniceus* is not of uncommon occurrence, when one is on the lookout for such specimens. In the collection before referred to, are several males with the deep red and yellow colors upon the wings, but which in other respects appear very different. The color at a short distance appears yellowish-brown, which upon closer inspection, results from that color tipping all the feathers over the body. In another specimen, the red of the wing is replaced by deep orange.

Frequent specimens of *Sturnella magna* occur which would readily be taken for *neglecta*, were the observer ignorant of the locality. They resemble the latter very closely, but do not have the characteristic note of the western variety. There are more

than half a dozen specimens in the aforesaid collection, all having similar markings and shade.

In addition to the above, *Calamospiza bicolor* frequently varies. Odd white feathers are scattered indiscriminately over the neck or breast, as was noticed in a number of specimens secured on Heart River, Dakota Territory. One specimen in my collection, has but a single white feather on the throat, though that appears rather prominently upon the black back ground.—*W. J. Hoffman, M.D.*

Mode of Moulting of the Lining of Crop and Stomach in Insects.—Attention has been lately directed to the mode of moulting by German zoölogists, especially from the histological stand-point, with interesting results. Dr. Braun has published an article on the histological occurrences in the moulting of *Astacus fluviatilis* in Semper's Arbeiten (ii. p. 120, 1875). In the same Journal and volume Cartier gives the results of his studies on the finer structure of the skin of reptiles, Kerbert has recorded his observations on the skin of reptiles and other vertebrates in Schultze's Archiv. für Microscopische Anatomie (xiii), and, during the past year, Dr Wilde has made known his observations on the mode of moulting in the grasshoppers and locusts (Wiegmann's Archiv).

In the reptiles as well as in the craw-fish (*Astacus*), moulting is effected by the growth of fine cuticular hairs of temporary growth which originate on the new skin, and grow up, thus loosening and pushing off the old skin. When this is accomplished these deciduous hairs disappear. This has been observed in the reptiles as well as in Astacus. Exceptions to this rule only occur in the reptiles on certain parts of the body, as for example the under side of the scales, the capsular skin of the eyes; in the crawfish the faceted cornea of the eye, the eyestalk itself, and the inner lamellæ of the fold of the carapace over the gill-openings.

It has probably been noticed by many that in moulting, the crayfish and lobsters cast off the solid chitinous lining of the crop and fore-stomach (proventriculus) the large teeth lining the latter remaining within the cast skin. It is so with the chitinous, teeth-bearing lining of the crop and fore-stomach of insects.

Dr. Wilde maintains that the moult of the crop and proventriculus (fore-stomach) follows that of the integument, and according to Braun the formation of a new cuticle in the stomach of the crayfish results at rather a late period after the change of skin. In the Orthoptera (grasshoppers and locusts) as soon as the moulting has taken place, the old cuticula of the crop and fore-stomach has disappeared. Wilde found that in several species, when about to moult, in all cases the old chitinous layer of the crop and fore-stomach was separated from its under layer, a new cuticula already being present. If we cut open the crop longitud-

inally we can remove the old cuticle without difficulty, a proof that it is cast off *in toto*.

Braun has maintained that the solid hairs and their modifications in the crop and fore stomach of the crawfish, are comparable with the cuticular hairs of the same animals; i. e. are merely for ornamentation, but Wilde considers that the homologous spiny hairs in the crop of the Orthoptera triturate the food (their function is, however, evidently to prevent the food from regurgitating into the mouth, together with the peristaltic action of the crop and digestive canal). That these hairs lining the crop and fore-stomach are useful in throwing off the old cuticle is plain, but this is only a purely secondary use. Wilde says he has observed the process of moulting in *Locusta viridissima*, *Decticus verrucivorus* and *Gryllus campestris* in the clearest manner, favored in part by the peculiar inner structure of the crop in the last. All the hairs and hair-like growths in the crop and proventriculus of the Orthoptera, take their origin not from cell-tubes, as is mostly the case in Astacus, but they are in the Orthoptera much more solid, and originate like spines on the chitine cells, like the projections on the flame-like cells (flammenzellen) of the walrus, as observed by F. E. Schulze. In no case is the moulting, in Orthoptera, performed as in Astacus and the reptiles, where two or three solid bristles are developed in a cell, by which the old cuticle is loosened. In the Orthoptera it rises simultaneously throughout its extent, so that the new cuticle rising under it, whether in the form of hairs or flattened, hairless chitinous growth, elevates the old cuticle as it keeps on growing (Fig. 23). As soon as the old cuticle is stripped off, the new cuticle completely formed is to be seen under it. It is, indeed, completely hyaline, and reminds one of the cuticle in the orthopterous larva, just after exclusion from the egg. Yet it takes on, after a few days, probably through the influence of the air, which passes through very fine tracheal twigs under the layer of epithelium, the characteristic yellow-brown color of the chitine. The secretion of the new cuticle must proceed with great rapidity. It does not take more than one, or at least two days to develop. Wilde does not state how the cast chitinous lining of the crop and proventriculus passes out of the narrow œsophagus and pharynx.

Ornithological Notes.—The habit of laying in other birds' nests is a well-known peculiarity of the cow-blackbird (*Molothrus pecoris* Sw). It seldom happens, however, that the intruder is successful in depositing more than one egg in a nest, yet I found a grass-finch's nest last summer which contained five eggs, three of which had been laid by the cow-bird. On the plains of Colorado I have frequently found single eggs of the latter deposited on the bare ground, and this fact was accounted for by the absence of timber in which birds might find suitable conditions for nidification. In one day I picked up *two* eggs of the cow-

bird at widely separated points, and an examination discovered them to have been recently laid. In the absence of the nests of other birds, therefore, the cow-bird will drop its eggs indiscriminately in times of sudden or unexpected delivery.

I met also, a few years ago, with a singular case of the ovipositing (or reproductive parasitism, I could not determine satisfactorily which) of the meadow-lark (*Sturnella magna* Bd.), in some degree analogous to that of the yellow-billed cuckoo. One nest which I found near Parkesburg, Penna., contained five eggs which had been laid at two distinctly separated periods, and, to all appearances, by two different individuals. Three of the eggs were smaller than the ordinary eggs of this bird and were so far advanced in the stages of incubation that I found it impossible to remove the contents without destroying the shells. The remaining two, however, were much larger and perfectly fresh. There was no doubt, however, that all were of the same species.—*E. A. Barber.*

ANTHROPOLOGY.[1]

On the probable use of Discoidal Stones.—There is one class of pre-historic relics which has been treated or referred to by nearly every writer upon archaeology, with nearly as many theories and conjectures as to the probable use. Schliemann devotes many pages to illustrations, most of the specimens bearing exquisite designs in ornamentation. England, Ireland and several continental localities have yielded numerous examples of the same style of relics with less ornamentation. The mounds throughout the Ohio and Mississippi valleys have furnished many highly wrought specimens, but rarely any with any attempt at ornamentation. These relics occur of various materials, such as diorite, syenite, quartzite, novaculite, greenstone, jasper, and in a few cases catlinite. They are circular, concave on either side sometimes, and I might say generally have a hole in the middle, varying from one-eighth to one-fourth of the total diameter. The periphery is seldom flattened but usually slightly convex, showing no trace of wear, but on the contrary, perhaps more highly polished, if that be possible, in many of those found.

There are two predominating sizes; specimens of the first class averaging from three to six inches in diameter, while those of the second are generally less than two inches. These may again be subdivided according to their perforation, ornamentation, etc., but it is not our purpose to dwell upon these points. The smaller specimens, which are found to exceed the larger in great proportion, were no doubt used in games, similar to tossing pennies and winning upon certain pre-arranged agreements. There may have been some colors used to distinguish one side from the other, and as colors, manufactured and applied by aboriginal races are easily removed, we can readily account for their absence

[1] Edited by Prof. Otis T. Mason, Columbian College, Washington, D. C.

after years of exposure or burial. Many of our American tribes play games in which four, five, or even six small bodies are employed, upon one or both sides of which lines or other characters are cut or burned to serve the purpose of ready identification. The Dakotas make beautiful specimens from the seeds of *Prunus virginianus*, upon which lines are burned so as to give the stone the appearance of a beetle.

These stone relics were not employed in hunting, by throwing at birds or game, as some have ventured to suggest, as the time and labor employed in their manufacture would have been more than lost. I doubt if any were suspended as ornaments or charms, as the constant wearing of a cord would eventually leave its impression upon the sharp edges, and then for a warrior to be impeded by any weighty and unnecessary ornaments is inconsistent with aboriginal customs. A disk made of catlinite, measuring about three inches in diameter, was recently found among a sub-tribe of Utes in south-western Colorado. The specimen is little more than half an inch thick, having a perforation in the centre around which are cut a series of narrow circles extending nearly to the outer edge. The opposite side is perfectly smooth. As this was used in gaming, by tossing into the air and betting upon the side to turn up, we are led to suppose that similar relics were used by other tribes for similar purposes. That the relics of the mound-builders are of much superior workmanship is granted. None of the implements of the modern Red race will compare with them, therefore we can scarcely expect to find any relics of this class in as good condition, or as perfectly finished.

The larger discoids were used for another style of amusement. The materials employed in their manufacture are usually of the hardest species of stones or rocks, as they were in greater danger of being broken. These larger discoidal stones were undoubtedly used in playing what is now termed the *chunge* or *tchunge* game. To illustrate my reason for the supposition I shall submit some remarks and references from a recent report made to Prof. F. V. Hayden.[1] Catlin[2] gives a description of the *tchung-kee* game as one of the amusements of the Mandans. This was played with a stone ring two or three inches in diameter. Prince Maximilian[3] also noticed this among the Mandans and Manitaries (Minnetarees). The Abbé Em. Domenech[4] describes a game of this character as observed in the extreme western portion of the continent. Adair[5] describes the national game of the Cherokees under the

[1] Miscellaneous ethnographic observations on Indians inhabiting Nevada, California and Arizona. W. J. Hoffman. U. S. Geolog. and Geog. Survey of the Territories. 1876. pp. 461–478.

[2] Illus. of the Manners, Customs and Conditions of the N. American Indians, etc. 10th edition. Vol i, p. 132, pl. 59. London. 1866.

[3] Travels in the interior of North America. London, 1843, p. 358.

[4] Seven years residence in the Great Deserts of North America. Vol. ii, p. 197. London. 1860.

[5] Hist. of Am. Indians, etc. Page 401 *et seq.* London. 1775.

name of *chungke*, and gives a detailed description. Jones[1] says, "The great game upon which the Southern Indians stake both personal reputation and property was the *chungke game*." For further reference to this game, and the tribes by whom it was played, I would refer the reader to works by DuPratz,[2] Brackenridge,[3] Lewis and Clark,[4] Turner,[5] Morgan[6] and Prickett.[7] I saw a game of this sort played by the Coyotèro Apachès, which will be described farther on. As far as I am able to learn, it is indulged in, to-day, only by this tribe. The Cuchanos (Yumas) played a game of this kind until recently; which they called *mo-upp*, the Mexicans termed it *redondo*.[8] Lieut. Whipple[9] in speaking of the Mojaves says, "Some of the young men selected a level spot, forty paces in length, for a play ground, and amused themselves in their favorite sport with hoop and poles. The hoop is six inches in diameter, made of an elastic cord. The poles are straight and about fifteen feet in length. Rolling the hoop from one end of the course, two persons chase it half way, and at the same instant throw their poles. He who succeeds in piercing the hoop wins the game."

As far as I was able in ascertaining, this game was not played by the Mojaves in the immediate vicinity of Camp Mojave (A. T.) in 1871, at which time I had occasion to visit that locality in a scientific capacity.

Since enterprising traders and settlers have established themselves at or near all the Indian reservations in the country, the aborigines have almost entirely discontinued the manufacture of implements and weapons of stone, substituting such articles as can be purchased to answer the requirements of the game. Thus instead of spending days of patience and labor on a stone ring or discoid, one can be constructed of twisted raw-hide or wood in a few hours, which answers the purpose as well or even better.

The Coyotèros above mentioned play a game similar to that of the Mojaves, corresponding in all particulars also to the so-called *chung-kee* game. A perfectly level piece of ground is selected, which is afterward retained for this game only. A distance of about twenty-five paces is marked off, having a width of about four feet. Two play the game, and the necessary materials required are a pole for each of the players, and a hoop made of a

[1] Antiq. of the Southern Indians. 1873, p. 96.
[2] Hist. of Louisiana. 1720. p. 366.
[3] Views of Louisiana, p. 255, 256.
[4] Lewis and Clark (by Paul Allen). Philadelphia. 1814. Vol. i, p. 143.
[5] Traits of Indian Character. Vol. ii, 1836, p. 168. [Extracted (in substance) from Halliday Jackson's "Civilization of the Indians."]
[6] Third Ann. Rep. of the Regents of the Univ. of N. Y., 1850. p. 81.
[7] History of Alabama, etc. Charleston. 1851. Vol. i, pp. 141–143.
[8] Emory's Report. U. S. Mex. Bound. Sur. Vol. i, p. 111. See also "Bartram's Travels in N. and S. Carolina," etc. Philadelphia: 1791. London (2 vols.): 1794. Paris (2 vols.) an vii.
[9] Pac. R. R. Rep. Vol. iii, 1856, p. 114.

branch of tough wood nearly an inch thick, which is formed into a ring having a diameter of about six or seven inches. This is sometimes wrapped with raw hide or sinew. Then there are two cords running horizontally across the inner space, intersecting two similar ones attached vertically, giving the middle the appearance of the cross-wires in an engineer's transit. The poles are each about fifteen feet long, consisting of spliced pieces of cottonwood, and having the general appearance of a good sized fishing rod with the thin end slightly turned upward. When the players are ready, they take their positions at one end of the course, and one of them placing his forefinger on the periphery of the hoop and grasping the sides with his thumb and fingers, rolls it with sufficient force to drive it to the other end of the course. When it is half way the players start abreast, pushing their poles on the ground before them. When they reach the middle of the course the poles are pushed ahead so as to pass through one of the spaces between the cords, the game resulting upon some previous agreement as to what was required in counting. This is repeated from the end where the first attempt terminated, and continued for hours. I have seen men lose blankets, horses, bows and arrows, and in fact almost everything of which they were possessors.

Similarities between this and closely allied games formerly practiced might be noticed, but it is not the object of the writer to more than refer to the probable use of the discoids as mentioned in the beginning.—*W. J. Hoffman, M D.*

Tribes of California, by Stephen Powers.—In the May number of the Naturalist attention was called by a brief note to the third volume of contributions to North American Ethnology, edited by Major J. W. Powell, and especially to the portion of it written by Mr. Stephen Powers. The great merit of Mr. Powers' work demands for it a more extended notice. In addition to acute powers of observation, great tact in dealing with the Indians, and a genuine sympathy, the author enjoyed during a portion of his three years the official recognition of the Interior Department and of the Smithsonian Institution. He speaks, therefore, as one having authority. Taking Herbert Spencer's descriptive sociology as a guide in estimating the exhaustiveness of any ethnographic work, we commence necessarily with Mr. Powers' account of the environment of the California Indians. On this point the author is extremely lucid and exhaustive, seizing as if by intuition the relation of the people to the land, and expressing it in language exceedingly terse and attractive. The reader will be especially charmed with those sentences in which the winds, the sky, the storm, and the darkness are brought into relation with savage life and feelings. The tone of sadness with which the great depletion of former populations under the blighting effect of the worst element of our civilization is narrated, is thought by some to be gratuitous; but Mr. Powers in his letter to Major Powell

(with a generosity as rare as it is refreshing, quoted in full in the opening address to the Secretary of the Interior) remarks characteristically, "If any critic, sitting in his comfortable parlor in New York, and reading about the sparse aboriginal populations of the cold forests of the Atlantic States, can overthrow my conclusions with a dash of his pen, what is the use of the book at all?"

Upon the next point, the physical characters of the California Indians, the work of Mr. Powers will be unsatisfactory. As to external characteristics, stature, color, &c., he is sufficiently explicit, and frequently quite original in his method of description; but the comparative anthropologist demands more than this now. The volumes of instructions issued by the Société d'Anthropologie, by the Anthropological Institute, by the German government to the merchant marine, by the Austrian government, and by other anthropological societies, attest the anxiety of leading savants to reduce every investigation to absolute measurement. With reference to the psychological characteristics of the various tribes, Mr. Powers is more explicit; indeed the author is again at home and leaves nothing to be desired as he lays bare, in order, the good and the bad that are in the Indians whom he is describing. This discriminating power is well illustrated by a remark of Mr. Powers concerning the Wintun, p. 229. "With that toughness and tenacity of life characterizing some of the lower order of beings, they have lived on and possess their homes while better and braver races have gone to oblivion."

In the culture-historical portion of the work, the author is decidedly in his proper element. Nothing has escaped his eye. As he proceeds from tribe to tribe, we have recorded for us every article of diet and drink throughout the year, and all the herbs that enter into their pharmacopœia; the size and shape, the material, and the mode of construction of their dwellings, together with their furniture, vessels, and appurtenances; the style of dress of both sexes, and of all ages, classes, and occasions; their implements of every craft with the manner of using them; their games and pastimes, especially their gambling, of which they are passionately fond; their music, over which the author grows, once at least, quite sentimental, p. 212; their domestic life in the marriage relation and in the management of children, including the discussion of prostitution and adultery, and the curse of infanticide; their social system and customs, together with their governmental organization and administration; last of all their religion, which has no "idea of the 'Great Spirit,' for these people are realistic and seek to personify everything," nor of "happy hunting grounds," for the indolent Californian, reared in his balmy clime knows nothing of the fierce joy of the Dakota hunter, but believes in a heaven of "hedonic ease and luxury." A valuable addition to the work is the collection of vocabularies made principally by Mr. Powers and Mr. George Gibbs and collated in the appendix.

The remarks of Mr. Powers upon these dialects, both in the introduction and throughout the volume add greatly to the value of this linguistic material. The following table will give some idea of the contents of the work and of the accompanying vocabularies.

LINGUISTIC STOCKS:

1	Tinneh.	Chapters	VI.—IX., XI., XIII.		
2	Yurok.	"	IV. and V.	Vocabularies page	460.
3	Karok.	"	I., II., III.	" "	447.
4	Chimariko.	No description.		" "	474.
5	Wishosk.	Chapters	X. and XI.	" "	478.
6	Yuki.	"	XIV., XV. and XXI.	" "	483.
7	Pomo.	"	XVI.—XX. and XXII.	" "	491.
8	Wintun.	"	XXIII.—XXV.	" "	518.
9	Shasta.	"	XXVI.	" "	607.
10	Modok.	"	XXVII.		none.
11	Achomawi.	"	XXVIII.	" "	601.
12	Maidu.	"	XXX.—XXXII.	" "	586.
13	Mutsun.	"	XXXIII.	" "	536.
14	Yokuts.	"	XXXV.	" "	570.
15	San Antonio.	No description.		" "	568.
16	Santa Barbara.	"	"	" "	560.
17	Washo.	Located on Linguistic Map.			
18	Shoshoni.	"	" "		
19	Yuma.	"	" "		

Accompanying the volume is an excellent colored map prepared under the immediate supervision of Major Powell, and locating each of the nineteen stocks as nearly as it can be done, considering the fickleness and migratory habits of the Indians and the crowding of the white settlers.

ANTHROPOLOGICAL NEWS.—On the 5th of April, Mr. Albert S. Gatschet read a paper before the American Philosophical Society on the "Timucua Language," formerly spoken in the eastern part of Florida as far south as Tampa Bay. The paper is based upon the works of Padre F. Pareja, in the Library of the N. Y. Historical Society. In one of the volumes Mr. Gatschet found a loose sheet of paper on which a Mexican had carefully transcribed the Lord's Prayer from a volume entitled "Explicacion de la 'Doctrina' que compusó el Cardinal Belarmino por mandado del Señor Papa Clemente VIII. Traduida en lengua Floridana por el Padre Fr. Gerorio Muoilla, &c., &c., Mexico, 1635."

No. 318 of the Smithsonian Publications is an illustrated quarto brochure of 35 pages and 10 plates, entitled "On the Remains of Later Prehistoric Man obtained from the caves in the Catherina Archipelago, Alaska Territory, and especially from the caves of the Aleutian Islands," by W. H. Dall. In the first part of the paper the author calls attention to the differences between the Kaniag'muts, or typical Eskimo tribes, and the Aleüts, or Aleutian Islanders. He then refers to the burial customs of the latter, especially at the time of their first discovery by the Russians. The chief attraction of the contribution is the illustrated description of the collection of mummies or desiccated bodies from a

cave in the island of Kagamil, one of the group known as the Islands of the Four Mountains, or Four Craters. These mummies were deposited in the National Museum in 1874, and quite extended notices were published at the time; but Mr. Dall's publication has brought the information into a permanent form. The heliotype plates are beautifully executed and greatly help the understanding of the text.

It gives us great pleasure to welcome the first number of *The American Antiquarian*: A Quarterly Journal devoted to Early American History, Ethnology and Archæology. Edited by the Rev. Stephen D. Peet, and published by Brooks, Schinkel & Co., Cleveland, Ohio. The leading article is upon Ancient Garden Beds of Michigan, by Bela Hubbard, illustrated by four plates, which the binder has carelessly inserted in the wrong order. The article of next importance is by the editor, upon the Discovery of the Ohio: Early Maps of the Great West. The other articles, which our space does not allow us to particularize, are all valuable materials to be worked up eventually into a comprehensive work on North American Archæology.

Anales del Museo Nacional de Mexico, Entrega 3ª, contains two archæological papers: "Un cincel de bronze de los antiguos Aztecas," Sr. D. G. Mendoza, and "Codice Mendozino: Ensayo de descrifacion geroglifica," per Señor Don Manuel Orozco y Berra.

In the February number of the *Journal of the Anthropological Institute* is a communication entitled "Customs of the New Caledonian Women belonging to the Nancaushy Tiné, or Stuart's Lake Indians, Natotin Tiné, or Babines, and Nantley Tiné, or Frazer's Lake Tribe, from Information supplied by Gavin Hamilton, Chief Factor of the Hudson's Bay Company Service. The same journal contains the report of the Anthropometric Committee, with color-plates; The Ethnology of Germany, II; The Germans of Cæsar, H. H. Howorth; The Migrations of the Saxons, Part III, id.; The Croats, id.; Flint Flakes from Egypt, Capt. R. Burton; Notes on Socotra, Capt. F. M. Hunter; Australian Languages and Traditions, Rev. C. C. Greenway, Thomas Honery, Mr. McDonald, John Rowley, Dr. Creed, C. H. E. Carmichael.

Mr. Francis Galton read a paper before the London Anthropological Institute, April 30th, on composite portraits made by combining those of various persons into a single resultant figure. A good report of the method is given in *The Academy*, May 11. In the same number is a brief report of a paper by Mr. C. Staniland Wake on "The Origin of the Classificatory System of Relationships used among Primitive People." The author takes issue with Mr. Morgan's explanation of the classificatory system as having originated in the practice of marriage among consanguinei.

The latest advices from Paris bring word that instead of the "Seances plénières internationales," there will be a congrès international des sciences anthropologiques, beginning June 24th, and continuing three days. The latest advices report over three hundred French exhibitors and nearly as many foreign.

By some misdirection of the subscription we have been deprived of the *Revue d'Anthropologie* for a year, but the numbers for January and April of the present year come to make amends for the loss. The January number opens with a paper by the editor upon the brain of the gorilla. The author admits that the progress of research has taken this investigation somewhat away from anthropology. "Les transformistes s'accordent généralement à reconnaître que l'homme ne peut descendre d'aucun des anthropoïdes connus, ni même d'aucun autre genre vivant." The second paper is by A. Hovelacque upon the classification of languages in anthropology. The author first examines the geographical, physiological and psychological methods and rejects them. He then seeks to divide languages by structure simply without any regard to relationship. "Two idioms may be monosyllabic, agglutinative or inflected, without having any bond of relationship. The Basque and the Japanese are both agglutinative, but their roots are entirely distinct. The natural classification of language does not accord in any way with the anthropological classifications which the present state of the science presents. Originally, language corresponded to race, that is to say certain races have given birth to linguistic systems similarly diverse, but the revolutions of time have broken up all that. The unfortunate maxim "Like race, like language," has retarded the progress of anthropology and linguistics.

The article by Dr. E. Hamy, upon the First Inhabitants of Mexico, has already been noticed in the NATURALIST.

In the Revue Critique the work of Dr. Boudin upon Pathological Anthropology is extensively noticed. The author endeavors to trace out the relation between race and diseases, such as pulmonary phthisis, variola, syphilis, malarial fevers, yellow fever, cholera, and the bite of serpents, and also the amount of vital resistance and the longevity of various races.

The Revue Prehistorique is conducted by M. G. de Mortillet, and consists of short, pointed articles upon the papers and works which have appeared in this department. The review of works and journals occupies fifty-four pages. From page 158–184 is the text in full of Dr. Broca's address before the French Association last summer upon the fossil races of Western Europe. The number closes with the Bibliographical Bulletin. The work is really the anthropologists' *vade mecum*, and it is hoped will receive the liberal patronage which it deserves.

Those interested in the relation of the phonograph to phonology will find interesting articles upon the subject in *Nature*, almost

every number containing something from such able men as Mr. A. J. Ellis, etc.

The third livraison of Matériaux contains the following articles of general import: Tombeaux du temps des habitations lacustres en Suisse, Rodé; Huitieme congrès annuel de la Societé Allemande d' anthropologie, by Graf Gundaker Wurmbrand; L'age de la pierre dans les souvenirs et les superstitions populaires, E. Cartailhac; Armes et Objets de parure des cabinets de l'Universitié jaguellone à Cracovie, Ernest Chantre; Le Musée des antiquités nationales de Saint Germain-en-Laye, H. Mazard.

Attention is called to the following titles: An inquiry into the reputed poisonous nature of the arrows of the South-sea Islanders, by Dr. A. B. Messer, Jour. of the Anthrop. Institute, Feb., 1878; The Ethnology of Germany, Parts II and III, H. H. Howorth, id.; Australian Languages, &c., several papers, id.; Flint Flakes from Egypt, by Capt. R. F. Burton, id.; The Spread of the Slavs, Part I: The Croats, by H. H. Howorth, id ; Notes on Socotra, by Capt. F. M. Hunter, id.; The Characteristics of the Malayo-Polynesians, by the Rev. S. J. Whitmee, id.; Amusements of the English People, by G. Turner, *Nineteenth Century*, Dec.; English Folk-lore, *Leisure Hour*, Jan.; La Chronologie prehistorique, &c., *Rèvue Scientifique*, Jan. 19; L'histoire de la civilization et la science de la nature, by M. DuBois Reymond, id.; Primitive Property, by M. Laveleye, translated by G. R. L Marriott, and published by McMillan & Co.; The *Verhandlungen* der Berliner Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte for 1877, contains very important contributions to general anthropology; Einige Bemerkungen über die urgeschichte Nord deutschlands, *Das Ausland*, No. 8, 1878; Review of Schliemann's work, id, No. 7; Les trois premières Années de l'Enfant, by Bernard Perez (Balliére, Paris); The Art of prehistoric Greece, by A. H. Sayce, *Academy*, March 2d; Art-weaving among the Ancients, by T. Nelson Dale, *Penn Monthly*, Feb.; Le Khedive et L'Egypte, by M. Van der Berg; *Rèvue Scientifique*, Jan. 26th; War rites of the Zulu-Kaffirs, *United Service Magazine*, Nov. 3d; The Leading Religions of the World, by Sir P. Colquhoun, a paper read before the Royal Society of Literature, Feb. 27th; Die orientalische Frage als cultur-Frage, by Fredrich von Hellwald, *Das Ausland* No. 5, 6 and 7; Primitive culture of the Babylonians, by W. St. Chad Boscawen, reviewed in *Academy*, March 9th; Culturgeschichte des Orients unter den Chalifen, by A. Von Kremer, reviewed in *Academy*, Feb. 2d and March 16th; Polyandry in Northern Hindustan, by J. Muir, *Indian Antiquary*, Nov., 1877; Slavonians and Rajpoots, by Sir Henry Maine, *Nineteenth Century*, Dec.; Tableau des Progrés faits dans l'etude des langues, de l'histoire, et des traditions religieuses de l'Orient pendant les annees 1875 and 1876, by Ernest Renan, *Annales Philosophie Chrétienne*, Nov. 12th; New Zealand and the South-

sea Islanders, by Sir Julius Vogel, London Colonial Institute.—*Otis T. Mason, Washington, D. C.*

The publishers of the NATURALIST furnish the editor of this department with a few separate impressions of the Anthropological Notes, and he will cheerfully supply copies to contributors of short sketches if they will send their address.

GEOLOGY AND PALÆONTOLOGY.

GLACIAL PHENOMENA IN BRITISH COLUMBIA.—In a recent pamphlet, entitled "On the Superficial Geology of British Columbia," Mr. G. M. Dawson draws fresh attention to the moraines, glacial grooves and ice marks in north-western America. His conclusions which we append are of a good deal of interest in connection with the former statements made as to the lack of glacial deposits in Alaska and neighboring regions southward.

1. The character of the rock striation and fluting on the south-eastern peninsula of Vancouver island shows that at one time a great glacier swept over it from north to south. The glacier must have filled the Strait of Georgia, with a breadth, in some places, of over fifty miles, and a thickness of ice near Victoria of considerably over six hundred feet. Traces of the glaciers are also found on San Juan island, and the coast of the mainland.

2. The deposits immediately overlying the glaciated rocks, besides hard material locally developed, and probably representing *moraine profonde*, consist of sandy clays and sands, which have been arranged in water, and in some places contain marine shells. These, or at least their lower beds, were probably formed at the foot of the glacier when retreating, the sea standing considerably higher than at present.

3. Observations in the northern part of the Strait of Georgia, and the fjords opening into it—where the sources of the great glacier must have been, show ice-action to a height of over 3000 feet on the mountain sides. The fjords north of the Strait of Georgia show similar traces. Terraces along the coast of the mainland are very seldom seen, and have never been observed at great elevations.

4. In the interior plateau of British Columbia there is a system of glaciation from north to south, of which traces have been observed at several localities above 3000 feet. Subsequent glaciation, radiant from the mountain-ranges, is also found.

5. The superficial deposits of the interior may be classified as unmodified and modified. The former, representing the Boulder-clay, hold many water-rounded stones, with some glacier-marked, and occurs at all heights up to over 5000 feet. The latter characterize nearly all localities below 3000 feet, and are most extensively developed in the northern low country, where they appear as a fine white sill or loess.

6. The interior is marked with shore-lines and terraces from the

present sea-level up to 5270 feet, at which height a well-marked beach of rolled stones occurs on It-ga-chuz mountain.

7. Moraines occur in great numbers. Some of the moraine-like accumulations may have been formed in connection with the north-to-south glaciation. Most of those now seen, however, mark stages in the retreat of glaciers towards the various mountain ranges. The material of the moraines resembles that of the Boulder-clay, but with water-rounded stones even more abundant.

8. The sequence of events in the interior region has been: glaciation from north to south, with deposit of Boulder-clay, formations of terraces by lowering of water-surface, accompanied or followed by a warm period; short advance of glaciers from the mountains contemporaneously with the formation of lower terraces; retreat of glaciers to their present limits. Glaciation of Vancouver island may have occurred during both the first and second cold periods, or during the second only.

9. If the north to south glaciation has been produced by glacier ice, it must have been either (*a*) by the action of a great northern ice-cap (against which grave difficulties appear), or (*b*) by the accumulation of ice on the country itself, especially on the mountains to the north. In either case it is probable that the glacier filled the central plateau and, besides passing southward, passed seaward through the gaps and fjords of the coast range. The Boulder-clay must have been formed along the front of the glacier during its withdrawal, in water, either that of the sea, or of a great lake produced by the blocking by local glaciers of the whole of the valleys leading from the plateau, to a depth of over 5000 feet.

10. If general submergence to over 5000 feet be admitted, the Japan current would flow strongly through Behring's Strait, and over part of Alaska, while Arctic ice-laden water, passing south across the region of the Great Plains, would also enter the central plateau of British Columbia, accounting for the north to south glaciation and simultaneous formation of the Boulder-clay.

THE SPECIES OF RHINOCEROS OF THE LOUP FORK EPOCH.—Prof. Cope recently exhibited to the American Philosophical Society the crania of three species of rhinoceros which he had obtained from the Loup Fork beds of Kansas and Colorado. Two of them which were new to science, he named *Aphelops fossiger* and *A. malacorhinus*. Of the third species, the *A. megalodus* (Cope), two crania were exhibited, one of them in a remarkable state of preservation. Three crania of the *A. fossiger* and one of the *A. malacorhinus* furnished their distinctive characters. The *A. megalodus* is the smallest species, and about as large as the smaller race of the *Rhinoceros sondaicus* according to Cuvier. It has a narrow elevated occiput, long and smooth nasal bones, a contracted preorbital region, and one large infraorbital foramen. The *A. malacorhinus* is a very peculiar species. It has very short

and small nasal bones, a broad front and a narrow and high occiput. The preorbital region is concave, and there are three infraorbital foramina. It is as large as the existing *Atelodus bicornis*. In the *A. fossiger* the occipital region does not rise above the level of the front, and is laterally expanded. The preorbital region is wide and convex, and there is one large infraorbital foramen. The size is about that of the *A. malacorhinus*, but the molar teeth are larger than those of the *Rhinoceros indicus*. They are peculiar in the great vertical depth of their fossæ, and the isolation of the posterior notch as a pit. This species was quite abundant during the period of the Loup Fork epoch, and were contemporaries of the *Mastodon campester* and several species of horses.

High and Low Water in the St. Lawrence River.—Unlike most rivers the St. Lawrence is not subject to sudden or very noticeable fluctuations in respect to the depth of its waters. It is stated, however, by residents in the vicinity that once in about seven years the water rises two or three feet above its ordinary level. There is no question but that this is the case in certain years, although it may be doubted whether the period of unusual rise commonly given is according to the fact. Two years ago, in the summer of 1876, the extraordinary height of the water in Lake Ontario and in the river above the rapids was a subject of common remark. The rise and subsidence are both gradual, continuing several months in the year mentioned, lasting throughout the entire summer and autumn. I am not informed in regard to the existence of any special records of observations made to determine the cause of this somewhat striking phenomenon. If it is due to an unusual fall of snow the preceding winter, causing an increase of water throughout the immense territory drained by this river, the fact can be determined directly from the Weather Reports furnished by the Signal Service Bureau.—*M. A. Veeder, Antwerp, N. Y.*

The Palæontology of Victoria.—As palæontologist to the Geological Survey of Victoria, Prof. McCoy has lately issued the fifth decade of the survey publications. This is a series of ten plates, with text, illustrating some of the more interesting fossils which have lately come under the notice of the surveyors. One of the more noteworthy of the fossils here described and figured is a curious object resembling the calcareous axis of a large sea-pen living in Hobson's Bay, but considerably larger. It is believed that it can claim a place in the European Tertiary genus Graphularia, and is accordingly described as *G. robina*. In shape the fossil is conical below and quadrate above, while internally it exhibits on fracture a radiating crystalline structure. Its interest lies in its curious resemblance to a belemnite. Sometime ago it was announced that a belemnite had been discovered

in Tertiary rocks in Australia, an announcement which of course created much surprise, since it had previously been an article of geological faith that belemnites were exclusively mesozoic fossils. Prof. McCoy now suggests that the fossil taken for a belemnite may have been the new Graphularia which he describes in the present decade, or some other very similar fossil. Another notable Victorian fossil noticed here for the first time is an eared seal of Pleistocene age, to which the name of *Arctocephalus williamsi* is given.—*Academy.*

GEOGRAPHY AND TRAVELS.

Geographical Notes.—The *Geographical Magazine* contains a map showing the Himalayan explorations of Mullah, one of the explorers of the Great Trigonometrical Survey of India.——Dr. Kirchhoff, President of the Halle Geographical Society, has discovered, in the library of the University, a copy (apparently) of part of the original log book of Captain Cook, during his voyage in 1772. The book was bequeathed to the library referred to by John Reinhold Foster, Cook's companion, who died in Halle.——Lieut. Wyse at last accounts was exploring the Isthmus of San Blas, the narrowest point between the Atlantic and Pacific oceans.——M. Deloncle of Lyons, concludes from documents in his hands, that (1) Lake Tanganyika was not known to be in existence at the time of the missionary journeys of the 14th, 15th and 16th centuries; (2) that Mayamuezi, Ugogo, Uganda and other districts were known in the fourteenth century; (3) that Lakes Victoria and Albert Nyanza, Banguelo and Moero had been explored at the same time; (4) that the wide northern affluent of the Lualaba, discovered by Mr. Stanley, issues from the Albert Nyanza; (5) that Lake Nyanza was a basin, much larger than now.——Dr. Traumuller of Leipzig, who resided at Batavia between 1867–1870, in the course of many excursions in the interior of Java, visited the volcanoes Gede and Panggerango, and the famous "Valley of Death." The carbonic acid gas which here accumulates to a height of two or three feet above the ground is noxious to small animals, but harmless to human beings. A former connection between Asia and Java appeared to the author to have once indubitably existed.——On the 6th of May, a little schooner, the *Willem Barents*, an eight ton craft, sailed from Amsterdam for a six months' cruise in the Arctic regions. The whole ship's company consists of fourteen—six scientific experts and eight sailors and officers. The enterprise is strictly national, foreign aid having been refused, and nothing even having been asked of the Dutch Government, but everything being supplied by voluntary contributions. The schooner will pursue the track of previous Dutch navigators, along the north-west coast of Spitzbergen, to Nova Zembla, and thence as far to the north-west as can be reached in season for the schooner to return before next winter.——The *Times* says the

Jeannette (*Pandora*) will be ready for sea in a short time, and then sail for Havre, where a temporary crew will be shipped, when she will leave for San Francisco. Mr. Bennett hopes the expedition will sail for the North in June, 1879. It will go by the route through Behring's Straits.——Prof. Nordenskiöld's expedition for the north-east passage sails in the *Vega*, in July.——The vessel *Eothen*, with twenty-five men, will sail from New York in July for the Arctic regions in search for the relics of Sir John Franklin.

MICROSCOPY.[1]

Determination of rocks by the Microscope.—At the regular meeting of the San Francisco Microscopical Society, May 16th, Mr. Melville Atwood presented twenty-two rock specimens illustrating a new method of preparing the same for determination, and read a very interesting paper on the subject. He is aware that looseness in petrological nomenclature is the rule and not the exception, and that many geologists are found writing of totally different rocks under the same name. But he is still more impressed with the ignorance of the miners in regard to the rocks which form the boundaries of the different mines. He does not value much any distinction between rocks which cannot be applied in the field, and he found, while making a collection of rock specimens prepared in different ways, that what was most wanted was a method to make it easy for his fellow-miners to understand and distinguish the enclosing and wall rocks of the different lodes they were working—these rocks having so much to do with the productiveness of the lodes. To prepare rocks so that they can be easily studied with a pocket lens or a low power of the microscope and accurately identified by comparison with a collection of foreign types, they are prepared as follows: "First wash the specimen clean, using a brush to get rid of any clay and dirt; then select the side or part you wish to examine, and grind it down on a piece of sandstone (a shoemaker's sharpening stone) until a perfectly flat surface is obtained. This will occupy but a few minutes unless the rock is very hard. The surface should then be worked down still finer with a square emery file, using water, and after you have obtained a sufficient polish, wash the rock again and then let it dry gradually, either on a stove or, what is better still, a little brass table with a spirit lamp, the same that is used for heating slides. When perfectly dry heat it again to a point so that you can barely handle it; then varnish the polished side while hot with a mixture of one part of Canada balsam to three parts of alcohol, which must be warmed before applying it, and laid on with a camel's hair brush. It will soon dry, and if left for a day or two will harden, so that you can handle it without injury." This simple and rough treatment is

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

described as remarkably successful in making plain the characteristics of the rocks.

OLEOMARGARINE.—Mr. John Michels has recently studied this substance, and drawn its appearance under the microscope. The abundant fat globules and occasional crystals of common salt which are found in real butter are almost entirely wanting, and in their place are found an abundance of large feathery crystals and of fragments of animal tissues. As the fat is merely liquified and set free by a heat not exceeding 120° Fahrenheit, and manipulated so as to have the general appearance of butter, any germs of disease or embryos of parasites it may have contained are liable to be preserved alive and transferred to the systems of those who make use of the substance. He therefore considers the oleomargarine, though for cooking purposes an excellent substitute for any fat previously used, to be eaten in a raw state as a substitute for table butter only at considerable risk.

Mr. E. J. Wickson described at the San Francisco Society the character of oleomargarine cheese. The cream from the milk is removed, and then liquid oleomagarine stirred in to replace the fat thus taken away. The mass is agitated, and rennet enough added to form a curd quickly before the oil can separate from the skim milk, in order to form an emulsion of oil and a menstruum of solid casein, like that which exists in cheese from natural milk. This process has succeeded so well that chemical analysis has shown the artificial cheese richer than the genuine, and so great an improvement on skimmed cheese that large quantities are sold in New York and shipped to Europe. Under the microscope this artificial preparation, on account of the imperfect emulsion formed, shows cavities of irregular shape in which the artificially introduced fat was imprisoned when the curd was formed, instead of the smooth mixture of fat globules found in cheese from full cream milk.

A RARE SALE.—The microscopes, objectives, accessories and objects of the late distinguished and critical microscopist, John E. Gavit, are now offered for sale by his son, W. E. Gavit, of Stockbridge, Mass., from whom catalogues and particulars can be obtained.

EXCHANGES.—The San Francisco Microscopical Society is now enabled, by the kindness of the State Geological Society, to offer return exchanges of Pacific Coast diatomaceous deposits on receipt of any valuable microscopical material.

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SCIENTIFIC NEWS.

— Professor Joseph Henry, of the Smithsonian Institution, died May 13th, at Washington, of Bright's disease of the kidneys. Professor Henry was born in Albany, N. Y., on the 17th of December, 1797. At the end of a course of study at the common

schools he entered the Albany Academy, where he displayed a marked taste for scientific and mechanical branches, and he followed a natural bent when he afterward learned the watchmaker's trade. In 1826 he laid aside his business to become an instructor at the Academy, and the next year began a series of experiments in electricity which introduced him to the notice of the world of scholars. Among his earliest discoveries was the fact that in the transmission of electricity for great distances, the power of the battery must be proportioned to the length of the conductor, and he was the first to magnetize a piece of iron at a distance or make use of electro-magnetism as a motor for machinery. In the last instance an oscillating iron beam was surrounded by a conductor or insulated copper wire. A current of electricity was sent through this in one direction, which caused one end to be repelled upward and the other attracted downward by two stationary magnets. The downward motion of the one end of the beam near its lowest point brought the conducting wires in contact with the opposite poles of the battery, which produced the reverse motion, and so on continually. In a later arrangement the velocity of motion was regulated by a fly-wheel, and electro-magnets substituted for the permanent magnets at first used.

In 1829 Prof. Henry prepared some electro-magnets of a power higher than any yet produced, and one which he afterwards constructed on the same plan, and which will sustain thirty-six hundred pounds with a battery occupying only a cubic foot of space, is still exhibited in the cabinet of the College of New Jersey. Continuing his investigations, he at length astounded his friends by applying the principle which we now see in use every day in the electric telegraph—making a bell to ring at one end of a wire a mile long by the transmission of a current from the other end; and in a paper printed in Silliman's *American Journal of Science* in 1831, he pointed out the possibility of employing such an agency for the instantaneous conveyance of intelligence from one point to another far distant. This, it must be remembered, was thirteen years before Morse put the idea into practical operation. Within a twelve-month of the time these startling experiments were published, Prof. Henry was called to the Chair of Natural Philosophy in Princeton College. In 1837 he visited London, where he interested Sir Charles Wheatstone, then a Professor in King's College, in his discoveries, elaborating some of them and suggesting the capabilities opened up by others. When the Smithsonian Institution was organized at Washington, Professor Henry was appointed its Secretary, and he has filled that responsible position ever since with distinguished ability. His research has been confined to no one department of science, and his zeal for the dissemination of results has kept pace with his devotion to the improvement of process. In 1872 we find him negotiating with the authorities of the Atlantic cable to procure the free transmission

of important discoveries in astronomy, till he has perfected a system by which an announcement is flashed from any part of America to the Smithsonian Institution, and thence to the observatories in Paris, London, Berlin and Vienna, all in a time scarcely long enough to estimate and without drawing a dollar from the proverbially low purses of the star-gazing fraternity. The same year witnessed the completion by the Royal Society of London of a "Catalogue of Scientific Papers"—a compilation of incalculable usefulness to scholars—mainly in response to a suggestion made by Professor Henry in 1858. To him we owe, perhaps, more than to any one man, our present position as a nation in the domain of meteorology; it was he who devised our system of weather despatches, and who forsaw the importance of tabulating them and preparing the daily maps now in use. As an astronomer he was a leading figure as early as 1845, when he published his observations on the temperature of the sun, which were confirmed by Secchi seven years later, and have remained unshaken in their passage through a score of hands since. As a topographer he took a lively interest in the changes of level in the neighborhood of the Great Salt Lake, and it is at his suggestion that a monument was erected there, in 1874, for the purpose of making standard measurements. It was he who, at the age of seventy-seven, successfully entered the lists with Professor Tyndall as an investigator of the questions involved in the perfection of fog signals for use on the ocean coasts. Thus in every domain he enters we find him an enthusiast and a master, his whole soul given to the advancement of the good of his race by practical means.

His place will be difficult to fill in many ways, but his loss will be especially felt on account of the influence of his noble moral character. He was a man of the clearest sense of justice, and would tolerate no wrong; yet as a good man he was not prone to suspect evil in others. His rectitude was equalled by his charity; but this virtue did not, as too frequently, impair the decision of his acts. He was essentially free from partisan spirit, and although his own views were broadly liberal, he had no sympathy with the methods of some of the modern apostles of liberalism, who while they destroy, fail to offer satisfactory substitutes. The young scientists of this country of the present generation, who have so often found him a friend in the past, are fortunate in the possession of his example for the future.

— The distinguished invertebrate palæontologist, Wm. M. Gabb, died May 30th, in this city, of consumption. He was born January 20, 1839, and was consequently in his fortieth year. He had returned home but a short time previous to his death from Santo Domingo, where he had so ably labored in his chosen pursuits—geology and palæontology. He began his career as geologist in the capacity of chief of the Geological Survey of Califor-

nia, to which post he had been assigned by Prof. Whitney. He made extensive geological and geographical explorations along the west coast, California, Oregon and Nevada; he also engaged in a survey of the peninsula of Lower California, of which it is said he made the most accurate map extant. His principal work, however, was his explorations in Costa Rica, and especially Santo Domingo, to the topography and geology of which he had given much study, and the results of which he embodied in his quarto report published by the American Philosophical Society. Numerous other papers on the secondary fossils of the United States, Santo Domingo and Peru were contributed by him to the Proceedings and Journal of the Academy of Natural Sciences and to the Transactions and Proceedings of the American Philosophical Society. American science sustains a severe loss in his death in the departments in which he labored, and to which he had contributed upwards of fifty papers up to the time of his death.

— The North Mountain Camp of Physical Culture, so successfully established by Dr. J. T. Rothrock in 1876, and continued last summer by Messrs. Taylor and Frank, will be open during the coming months of July and August, and will be conducted upon the same general plan as that of previous years.

The primary object of the Camp-School is *physical culture*. No stated lessons from books will be required, nor will close mental application be allowed, though a part of each day will be devoted to instruction, which will consist of lessons in Geology, Botany, General Natural History and Drawing from Nature.

The location of the camp is near a mountain lake in the southeastern part of Sullivan Co., Pa., at an altitude of over two thousand feet above tide.

As a rule, boys from twelve to seventeen years of age only will be admitted, though in exceptional cases it may be found proper to admit others.

For the term of two months the charge is $100. This includes boarding, washing and tuition. While it is desirable that pupils remain during the entire term, they will be received for any part of the term, and will be charged in proportion to the time spent in camp. In all cases, however, one-half of the sum must be paid on entering, and the remainder when the pupil begins the latter half of his term, of whatever length it is decided that shall be.

The better route to reach the camp is by the Lackawanna and Bloomsburg Railroad to Shickshinny, and thence by stage to the North Mountain House.

For further information address L. H. Taylor, University of Pennsylvania, Box 2838, Philadelphia, prior to July 1, 1878; after that, Shickshinny, Luzerne Co., Penna.

— The Bridgeport Scientific Society was organized last year with H. N. Powers, D.D., president, and Clarence Sterling, cura-

tor, and has issued a circular calling attention to the desire on the part of the society of establishing a museum to illustrate the natural history and archæology of Western Connecticut. Correspondents and donors should address Clarence Sterling, curator Scientific Society, Bridgeport, Conn.

— The Cincinnati Society of Natural History has issued the first number of its journal, the subscription price of which is $2.

— The Chesapeake Zoölogical Laboratory of Johns Hopkins University opened June 15th for a two month's session at old Point Comfort, Va., under the direction of Dr. W. K. Brooks.

— Mr. J. W. Groves, of the South London Microscopical Club, after cleaning glass slides for mounting microscopical objects, by one of the usual processes, fastens them together by their edges, after the manner of the well-known artist's sketching blocks. This is easily done with a pile of slips, by fixing around their edges a piece of ready gummed tissue-paper, ten inches long, and of a width suitable to the number of slides, so that, although they are firmly bound together, their surfaces are left uncovered. The block is left to dry, when each slip may be detached by running the thumb nail round its edges. The surface next the adjoining slip should be used for the preparation to be mounted on, as it is, of course, quite clean, although the exposed one may have become dirty; the fragments of tissue-paper are removed after the mount is completed.—*Quarterly Journal of Science, London.*

— Under the title of Essai sur le Classement des Animaux qui vivent sur la Plage et dans les Environs de Dunkerque, M. O. Terquem gives a catalogue, illustrated with five excellent plates, of the Foraminifera which live on the shores of Dunkirk, Belgium.

— The total production of silk-cocoons in Europe amounted upon an average to 58,000 tons per year during the last five years. Italy stands first in the list of silk-producing countries, producing 39,000 tons per year; France produces about 10,000 tons; Turkey 4000; Spain 2200; Austria 1900; Portugal 250; Greece 200; Russia 150; Germany 100, and Belgium and Switzerland only 100 tons together.—*Nature.*

— Arrivals at the Philadelphia Zoölogical Garden: 1 spotted sandpiper (*Tringoides macularius*); 1 zebu (*Bos indicus*) ♂, born in the garden; 2 lizards (*Holbrookia maculata* and *Crotaphytus collaris*), Texas; 2 Carolina parrakeets (*Conurus carolinensis*); 1 corn snake (*Coluber guttatus*); 1 mountain black snake (*Coluber obsoletus*); 1 blue-jay (*Cyanurus cristatus*); 1 ring-necked snake (*Diadophis punctatus*); 9 prairie dogs (*Cynomys ludovicianus*), born in the garden; 1 broad-winged buzzard (*Buteo pennsylvanicus*); 1 spreading adder (*Heterodon platyrhinus*); 1 pine snake (*Pityophis melanoleucus*); 1 glass snake (*Ophiosaurus ventralis*); 1 opossum and young (*Didelphys virginiana*); 1 scarlet ibis (*Ibis rubra*), South America; 2 copperheads (*Ancistrodon contortrix*); 1 great horned

owl (*Bubo virginianus*); 2 gray foxes (*Vulpes virginianus*); 1 raccoon (*Procyon lotor*); 1 garter snake (*Eutænia sirtalis*); 1 woodchuck (*Arctomys monax*); 5 alligators (*Alligator mississippiensis*); 2 wild boars (*Sus scrofa*), North Africa.

— A new industry has recently sprung up in parts of Minnesota, namely, frog culture; it is a simple matter, consisting chiefly in the protection of eggs and tadpoles from birds and other enemies, by means of wire screens. The product, thus far reported, amounts to 3,000 dozen of frogs' legs, of which about two-thirds have been shipped to St. Louis. The average quotation of prices is 20 cents per dozen.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Geographical Society.—May 14.—Mr. Jesse Young read a paper upon his recent journey of exploration as the astronomer of the Giles Expedition across the continent of Australia, with descriptions of the deserts, native races and the natural history of the country.

May 28.—Gen. C. Chaillé Long lectured on Egypt, Africa and Africans, embracing the following subjects: Egypt's annexations; the results of his expeditions in Central and Oriental Africa; his discovery of Lake Ibrahim and two hundred miles of the unknown White Nile; the source of the Nile; M'tse, King of Uganda; the Niam-Niams; Akka, or Ticki-Ticki, and the Anthropophagi and pigmy tribes.

Boston Society of Natural History.—May 15.—Mr. Richard Rathbun read a Description of a Coral Reef in the Bay of Bahia, Brazil. Mr. J. A. Allen spoke on the Fossil Birds of North America, and Dr. T. Sterry Hunt remarked on the Taconic Rocks of North America.

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SCIENTIFIC SERIALS.[1]

Transactions of the American Entomological Society.—The last numbers (1 and 2 of vol. vii.) of the Transactions of the American Entomological Society, contains some articles of unusual interest. Among them are Notes on some species of *Hister*, and an elaborate revision of the species of *Alemæodera* of the United States, by Dr. Horn, illustrated by a plate. Dr. Horn also contributes Notes on some genera of *Cerambycidæ* of the United States. A number of new North American *Hymenoptera* are described by Mr. E. T. Cresson, comprising mostly bees. The most important paper is Dr. Horn's Descriptions of the larvæ of the North-American genera of *Cicindelidæ*, also of *Dicælus*, with a note on *Rhynchophorus*, and illustrated with a plate, showing with more or less detail the larvæ of *Ambyrchila cylindriformis*, *Omus dejeanii*, *Tetracha carolina*, *Cicindela repanda*, *Dicælus* (*costatus? purpuratus?*).

[1] The contents of these journals are for the most part selected.

THE GEOGRAPHICAL MAGAZINE.—May. Prejevalsky's Explorations in Central Asia (with a map showing his route from Kuldja across the Tian-Shan to Lob-Nor and the Altyn-Tag, 1876–77). Himalaya explorations (with a map of the Mullah's new explorations in the Chitral Valley, and along the course of the Indus). The Cossacks, by C. A. G. Bridge. Salang Island, by A. de Richelieu. Droughts and climates at the Cape of Good Hope, by W. J. Black.

THE GEOLOGICAL MAGAZINE.—May. Geological Time, Part II., by C. L. Morgan. Erratics at high levels in North-western America—barriers to a great ice-sheet, by G. M. Dawson. Denudation—rain and river, by H. O. Forbes. The fossil-fish localities of the Lebanon, by G. R. Lewis. Occurence of a fresh water sponge in the Purbeck limestone.

SIEBOLD AND KÖLLIKER'S ZEITSCHRIFT.—April 23. Form of the crystalline cone in the eyes of arthropoda, by O. Schmidt. On Anomia, with remarks on the comparative anatomy of the muscles in Lamellibranch Molluscs, by H. V. Ihering. The poison apparatus and anal glands (secreting an odorous fluid) in ants, by A. Forel. Separation of the order of Oscines from the Clamatores, Scansores and Columbidæ by the structure of the egg-shell, by W. von Nathusius. Contribution to a knowledge of the postembryonal formation of the limbs in insects, by H. Dewitz On the ornamental colors of Daphnidæ, by A. Weismann.

May 7.—On the structure of sponges (Reniera), by E. Keller. Contributions to a knowledge of the urinary vessels of insects, by E. Schindler.

Supplement to May 7.—On the Amphipods and Isopods (structure of the antennæ, gills, &c.), by F. Leydig. On the development of the testes and on alternation of generations in Salpæ, by W. Salensky. On the method of Zoölogy, by P. Kramer. On the reproductive organs of some ectoparasitical marine Trematodes, by C. Vogt. The movements of flying fish through the air, by K. Moebius. Faunistic studies in the fresh water lakes of Switzerland, by F. A. Forel.

CANADIAN ENTOMOLOGIST.—April. Notes on *Grapta comma* and *interrogationis* (relates to dimorphism) by W. H. Edwards.

CANADIAN NATURALIST.—April 10. Notes on some Scottish Devonian Plants, by J. W. Dawson. Traveling notes on the Surface Geology of the Pacific Slope, by G. M. Dawson. On some Jurassic fossils from the Coast range of British Columbia, by J. F. Whiteaves. Notes on the Locust in the North-west, in 1876, by G. M. Dawson. The mechanical effects of Arctic ice in producing ocean currents, by H. Y. Hind.

THE

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THE INELIGIBILITY OF THE EUROPEAN HOUSE SPARROW IN AMERICA.

BY DR. ELLIOTT COUES, U.S.A.

IT is very regretable that the "sparrow question," which has already become a matter of national moment, should have degenerated into such a miserable personal controversy between the sentimentalists who misrepresent the facts and the ornithologists who understand them, that a prudent person, whatever his views, might refrain from having anything to do with it. But it is with me a matter of conscientious discharge of my duty to place the facts properly before the people, that they may be informed and warned in time, before the pest shall have become ineradicable. I do not write for ornithologists; for, so far as I am aware, there is not a scientific ornithologist in America, among those who have expressed any decided opinion, who are in favor of the wretched interlopers which we have so thoughtlessly introduced, and played with, and cuddled, like a parcel of hysterical, slate-pencil-eating school-girls. I have held a tight rein on this controversy from the first, and probably know more of its inside history than any other person; and I am in position to affirm that the sneers, the invectives, the ridicule and abuse, and the wild assertions of the leader or leaders of the pro-sparrow faction, result from a frantic despair in the face of the *facts* which ornithologists coolly adduce. The fact that the sparrow is a nuisance in a variety of ways, that it does not do any appreciable good, that it does a very obvious amount of damage, that it harasses, drives off and sometimes destroys useful native birds, and that it has no place in the natural economy of this country, are patent to every one who will take the trouble to see for himself. These same facts, some or all, are disagreeably obvious to

many persons, especially agriculturists whose fields and gardens are assailed. All of these same facts are admitted by competent ornithologists generally. None of them are publicly disputed, so far as I know, by any person or persons whose authority has any weight in a question of this kind.

The friends of the sparrow in this country fall in the following categories: First, those who know nothing and care nothing particularly about them, except that they "rather like" the pert and brusque familiarity of the birds—a class composed chiefly of children, women and old fogies. Secondly, those who are or were instrumental in getting the birds here, and are interested, either in reputation or in pocket, to keep them here. Thirdly, quasi-ornithologists who have been misled into hasty expressions of opinion to which they feel bound to stick. Fourthly, the *claquers* of the last, who play a sort of "Simon-says-up" game. Fifthly, a very few intelligent and scientific persons, but not practical nor professional ornithologists, who recognize fully what little good the sparrow undeniably does, and shape a favorable argument mainly from the undisputed advantages which result from a certain just and proper number of sparrows *in Europe*.

Most of my antagonists in this matter—those that fall in the first four categories above named—are of course not worth serious attention, for they either have no decided opinions of any sort, or else they are not open to instruction. But I have a particular word to say to those who draw an honest argument, not without some show of reason, from *the state of things in Europe*. I grant, if they wish, everything they adduce, from Prévost (who by the way is a great tally-ho! for the members of the third category above) to the last investigator of the contents of sparrows' crops; and I simply reply that the argument *does not apply to the case of the sparrow in America*. In Europe these birds are part and parcel of the natural fauna of the country. They are not, as I understand, petted, pampered and sedulously protected from their natural enemies as they are here. They shift for themselves, find certain sources of food supply, have a fair share of natural enemies, and are kept within due bounds of multiplication by natural causes; so that the "balance of power," to use a political phrase, adjusts itself. In short, they have their useful part to play, and they play it; they have their natural checks, and their increase is naturally checked. They are useful birds; and when,

after somewhat excessive multiplication, from any cause, they have been injudiciously exterminated in certain districts, it has been found necessary to re-stock such districts at great trouble and expense. All this, I believe, is admitted on all hands.

But the principle of *mutatis mutandis* does not apply to the sparrow in America. The things that would have to be changed to make the sparrows fit here cannot be changed. The complement of our avifauna was made up without these birds. There is no room for them; and if there is any work for them, time has shown that they slight it, or neglect it altogether. The only way to make the sparrows eat the worms they were imported to destroy, and which they seem to specially dislike, would be to starve them into such unpalatable fare. Instead of that, we sedulously feed them from our tables till they are grown too fat and lazy to think of worms. And if we did not do so, it would be useless to expect them to take to a diet they do not relish, when the streets are full of manure, of which they are specially fond, and the trees of our orchards and lawns are full of fruit-blossoms, and the gardens are full of small fruits, and the fields are waving with grain—all these things being the *natural* food of birds of the sparrow tribe, to whom an insectivorous diet is only an occasional and temporary variation.

Again, the matter of the limitless multiplication of these pestilent famine-breeders presents itself very differently in this country. They are extraordinarily prolific. A single female has been known to lay over thirty eggs in a season. They ordinarily raise three or four broods a year, and may have half a dozen at a time. They are safely housed from their natural enemies; rather, they have no special enemies in this country, and such enemies as their excessive abundance might raise up against them have, in at least one case, been summarily disposed of, as in the silly action of the Bostonians regarding the shrikes. There is thus practically *no* check upon their limitless multiplication, and they are insidiously multiplying at a rate that perhaps few suspect. A short ten years ago a sparrow was something of a sight anywhere; now, the millions we have are countless. The sparrows have played mischief enough already, I know; but I say deliberately, that this is nothing to what the next decade or two will witness if this desperate sparrow-mania goes on. We may have before long people knocking at the Congressional gates for an

appropriation for a Sparrow Commission, like the Grasshopper Commission now sitting, to consider if there be any available relief from the scourge. When the sparrows overflow into all the country—and they are beginning to do so already—and settle in hordes on the grain fields, a good many will doubtless be destroyed by the birds and beasts of prey; but it may then be too late. At present, an occasional stone from some idle boy, or an occasional cat on the woodshed, are all the sparrow has to look out for.

I think it will be evident that the *argumentum ad Europam* cannot logically apply here. I have dwelt upon it because it is the only show of reason I find in my worthier opponents; yet it is fallacious, thoroughly fallacious. The crude asseverations of the less worthy, the misrepresentations and tergiversations of interested persons, and all the vociferations of the pyrgitomaniacs are wasted in a case like this, or are not wasted only in so far as they serve to dress up a melodramatic spectacle, at seeing which well-informed persons usually smile. The philopasserites may be reminded that sentiment is not science, the present being a question of applied or economic science; that satire, ridicule and sophistry, however potent in the political or theological arena, are impotent in the field of science.

For the common good, as well as for the benefit of those who may care to defend the sparrows, I make the following specifications of my general charge against these birds.

1. They neglect entirely, or perform very insufficiently, the business they were imported to do. In spite of some good service at one season of the year, in a few particular localities, against some particular kinds of insects, the state of our shade trees remains substantially as it was before their introduction. Some of the decrease of noxious insects at times is due to their periodical decrease, with which the sparrows have nothing to do; and in spite of assertations to the contrary, people are still scraping trees, and employing the usual defenses against insects, in precisely those places where it was said that the sparrows had done the business.

2. They attack, harass, fight against, dispossess, drive away and sometimes actually kill various of our native birds which are much more insectivorous by nature than themselves, and which might do us better service if they were equally encouraged. This

fact is suppressed, explained away, or flatly denied, according to the disingenuousness, the aptitude for quibbling, or the audacity of the third and fourth categories of persons above described. It is attested, however, by numberless competent and veracious eye-witnesses.

3. They commit great depredations in the kitchen-garden, the orchard and the grain-field. We are only as yet on the very threshold of this matter, yet how obvious it is! And what may be expected, when, instead of a few hundred million sparrows, we have the millions of millions which will be ours in a few years, if we persist in this folly.

4. They are personally obnoxious and unpleasant to many persons. For myself, I "rather like" them too; they rather amuse and interest me, and are not at all disagreeable, as long as I can keep their disastrous results out of mind. I am not a delicate woman, nor yet a squeamish man, to be shocked by their perpetual antics during the spring and summer; being something of an anatomist I can stand it without embarrassment; but all are not thus constituted. Neither am I a nervous invalid, to be fretted and annoyed into positive illness by the incessant turmoil at the window; but others are. Nor do I, I regret to say, own a house where the steps and window-sills and trellis-work and lawn are so befilthed that none of my servants will stay if they have to clean up after the birds; others, however, are in such case. I grant that this is all a matter of taste, rather than of science; but such as it is, it is largely against the sparrows.

5. They have, at present, practically no natural enemies, nor any check whatever upon limitless increase. This would be undesirable, even in the case of the most desirable birds. As the case stands *we are repeating the history of the white weed and the Norway rat.*[1]

I have to make one suggestion and to offer two recommendations.

It is a fact, that with all this talk and counter-talk about the *food* of the sparrow, and to what extent it may feed upon insects injurious to our fruit and shade trees, nobody has yet made the experiments obviously necessary to determine exactly what the

[1] A writer in the *London Garden* says: "It may be remembered that in one of the back numbers of the "*Garden*," I mentioned that the introduction of the sparrow would turn out to be a great mistake, and they are now finding this out."

birds eat in this country. I would, therefore, suggest the obvious propriety of finding out exactly, in the only proper and scientific way, instead of sawing the air any longer in such futile way. I suggest, that, at the height of the insect season, at the time when the sparrows should be eating the bugs if they ever do, in some places fairly infested with the bugs, a sufficient number of sparrows be killed and examined in respect to the contents of their crops. Let the authorities of any of our large cities, preferably Boston, where the birds *are said* to have done so much good, and where the sparrow combination talks loudest, furnish to proper persons, say five hundred sparrows, whose stomachs shall be examined by some competent botanist and entomologist together. If noxious insects should be found to form the greater portion, or even any considerable portion of the food of these birds, I would yield the case as far as this particular count is concerned. At present I continue to believe that the scraping and other occupation of the city-forestering Othellos is not gone.

As to my recommendations: I am often asked, "Would you then have sparrows exterminated?" While I am not prepared to advise such an extreme measure as this, I do not hesitate to declare that prompt and stringent measures should be taken, as *a matter of national economy*, to check the increase of the birds. We have enough already. Without unnecessary cruelty, the numbers might be kept down, if not diminished, by the following gradually and continuously operating means:—

I. *Let the birds shift for themselves;* turn them loose and put them on the same footing as other birds. That is, take down the boxes and all the special contrivances for sheltering and petting the birds; stop feeding them; stop supplying them with building materials; let them take care of themselves.

II. *Abolish the legal penalties for killing them.* The birds are now under the arm of the law, which protects them from most of the natural vicissitudes of bird-life. Let the boys kill them if they wish; or let them be trapped and used as pigeons or glass balls are now used, in shooting matches among sportsmen. Vast numbers of pigeons are destroyed in this way; there are even "sparrow-clubs" in various cities, which make a business of practicing on various of our small birds, for which the European sparrows would be an admirable substitute, answering all the conditions these marksmen could desire. In this way the birds

might even be made a source of some little revenue, instead of a burden and a pest; they are to be had in practically unlimited numbers, and could be sold by the city to such persons as might desire to use them for sporting purposes.

The present article is to be regarded as a mere outline of the important subject. I have collected a voluminous mass of testimony during the past two or three years, which I intend to digest, in order to place the whole matter in its true light on permanent record, in treating of the species in the "Birds of the Colorado Valley." For the plague has spread even to that remote portion of our much be-sparrowed country.

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WALKS ROUND SAN FRANCISCO—THE BAY SHORE.

BY W. N. LOCKINGTON.

SOUTH of the city, on the shore of the bay, lies Mission creek, once no doubt as attractive a spot as any to be found in the neighborhood, but now converted into an exceedingly mal-odorous mud-flat, the recipient of the refuse of factories and of the drainage of the city. Right across the mouth of this creek, or rather bay, the Southern Pacific railroad has constructed a broad mole of earthwork, leaving no entrance save a narrow channel crossed by a drawbridge, over which runs the road leading to the part of the bay shore we have chosen for our excursion. Crossing the Potrero peninsula by a deep cut through the hill, we emerge upon the trestle-work spanning Islay creek, and after running the gauntlet of the powerful scents of Butcher-town, are at last deposited on the slope of the hill behind South San Francisco.

In front of us the San Bruno mountains stretch in a dark green line from bay to ocean; on our right runs a range of low hills, over whose tops the city is slowly advancing, throwing out the sentinels of scattered houses, and to our left spreads out its glorious Bay of San Francisco, glowing under the summer sun. The bay is broad here, and the coast range of Alameda county looks very distant and misty. Far away to the south, beyond the San Bruno hills, beyond the long stretch of lowland, backed by tree-clothed heights that lie behind them, till the shores grow indistinct with the distance, we can see the outline of this inland sea (for such it is), the shores drawing closer and closer as

they recede. In the far distance a thin line of smoke marks the position of a steamer *en route* to or from San José.

The shore of the bay in our vicinity is much indented by rocky peninsulas alternating with valleys, the outlets of which are filled either with a marsh or a lagoon, produced by the little streams that find their way from among the round-topped hills. Hunter's point, which is in our rear soon after we leave the cars, runs out into the bay two or three miles, then follows a marshy tract on which are placed the butts of a rifle company, then an isolated mound rising close to the edge of the bay, then a valley with a lagoon, and south of this, a lofty hill with serrated outline terminating baywards in a precipitous promontory, with a needle-rock as an outlier. This lagoon, the serrated hill and the beach around it are our hunting-ground to-day. We are armed with a spade and intend to dig for clams. Luckily it is low tide, a large area of silt is uncovered in front of the lagoon, and we hasten onwards to try our chances. Not that there is much risk of missing the clams when they spout beneath the feet at every step, and when every spadeful throws up at least two or three. The most abundant clam at this spot is the ubiquitous *Mya arenaria*, which also has possession of the entire beach near Oakland, on the Alameda county side of the bay; but the native Californian *Schizothærus nuttallii*, a monster of a clam when full grown, reaching a length of about seven inches, is also found here deep in the mud. Its ugly black siphon is as thick as a finger, and its gaping shell is clothed with a black epidermis. Along with the *Mya* a few individuals of the cockle, *Cardium corbis*, and of the Tellinoid clam, *Macoma nasuta*, are occasionally turned out by our unceremonious spade. Here is a large round burrow, with the sides as smooth as if plastered. This we know to be the dwelling-place of one of those fossorial cray-fish of which some four or five species occur along the Pacific coast, and we dig on, hoping to find a *Callianassa*, a genus that we are assured is found in the bay, but which we have never been so fortunate as to procure there, though we have found it in abundance at Tomales, some fifty miles to the northward. Out he comes at last, a fellow about six inches long, with a hairy rostrum and two pincers of equal size, swimming away for dear life. It is only *Gebia pugettensis* Dana, the commonest of common species. Whether living in the mud, in the sand, among stones, it is all the same to *G. pugettensis*. The dredging machines

in the entrance of Oakland harbor brought it up in abundance, and the deep-water specimens appeared to be larger than those found above low tide level. Attached to the swimmerets of Gebia, in the spring months, will usually be found a parasitic isopodous crustacean, *Phyllodurus abdominalis* St., an odd-looking creature, the two sexes of which differ a good deal in form. I have never found more than two upon a single Gebia, and these two are usually male and female, sometimes there is a female alone, but as the male is smaller and blessed with greater locomotive powers, he may in those cases have been overlooked or have escaped. The female is literally nearly as broad as she is long, with seven little pairs of legs ending in hooked claws tucked under her lob-sided body. The male is long and slender, symmetrical, with the segments of the body well separated, and is very much smaller than his unwieldy spouse.

Very often a small bivalve mollusc, *Pythina rugifera* Carpenter, is attached to one of the swimmerets of the larger Gebias. A large Nereis, about twelve inches long, gay with iridescent tints when placed in clear sea-water, completes the list of the silt-inhabiting creatures at this spot. All the cockles found are very small, yet shells of the species three inches across lie upon the beach, and at times the Chinese colony located near the lagoon is in possession of many a sackful of large individuals. An "old inhabitant" who has been clam-digging, volunteers an explanation of this. The bed of these cockles, he says, is below low water, and they are only washed ashore after a storm. "It puzzled him somewhat" at first, to find out where they came from.

A little farther on, as we leave the lagoon, the banks gradually rise into precipices, the beach is strewn with loose rocks, with here and there a larger boulder rising high among its fellows. We over turn a number of the smaller rocks, thinking it possible that we may find beneath them the large red *Cancer productus*, which is common enough in the bay, and which we have found in abundance at this season, in similar situations in Tomales bay. But either we are a little too early in the season to catch them so high out of the water, or they do not, in this locality, venture beyond low-water mark. Certain it is that we have not found them alive, with the exception of a straggler or two on the beach near San Francisco. But if, in July, we return to this spot, we shall find beneath many of these stones, each in a little puddle of

sea-water, many individuals of a singular fish belonging to the family Batrachidæ or toad-fishes. If we attempt to catch it, it will salute us, if we are not careful, by thrusting into our hands the sharp spines with which its gill-covers are armed, at the same time emitting a most characteristic grunt, which though not very loud is rather alarming to one unacquainted with the fish, and usually causes him, in conjunction with the wound from the spines, to drop it *instanter*. A glance at the under side of the rock which once roofed in her abode, will show us, covered as it is with ova about the size of a pea, that she comes to the shore to spawn. This fish, *Porichthys notatus* as it was named by Girard, is sufficiently ugly when looked at above, but its under side sparkles with rows of shining pores, emitting the mucus which covers its body and renders it as slippery as an eel.

Under every loose rock we turn over there is a colony of a pale greenish little crab, with a square carapax and whitish pincers which are uplifted menacingly at the unwelcome intruders as their owners scuttle off to hide themselves under the nearest shelter. This species, *Heterograpsus oregonensis* Dana, is commonest at this point, but it is often accompanied by the almost equally common and much prettier *Heterograpsus nudus* Dana, which attains larger dimensions, and has a carapax and legs beautifully marbled with red and purple brown. The first species is extremely abundant in the brackish creeks which permeate the marshes round the bay.

In the crevices of the larger rocks, up to quite high-water mark, another square crab, dark-green in color, and with the last joints of its four pairs of walking feet armed with spinules, by which it holds tightly to the slippery surface, may be found in considerable numbers, but it is rather difficult to secure entire, not only from the difficulty of reaching it in its hiding places, but from the extreme readiness with which it throws off some of its limbs when escape proves impossible. This is *Pachygrapsus crassipes* Randall. Farther on still, where the loose rocks are larger, the large *Cancer magister* Dana, the species usually eaten by the practical carcinologists of San Francisco, is occasionally found, having presumably retired from the deeper water to shed his plate-armor in peace. But it is too early in the season for him, and we encounter nothing new until, between two rocks, we see an eight-armed object crawling along, the arms united by a membrane, so

that it looks like a walking umbrella, the handle supplied by the elongated oval body which rises from the center of the disk. At the base of the body, next the arms, are a pair of goggle eyes, which seem to wear anything but an amiable expression as we cautiously seize him by the body and introduce him forcibly into a jar of sea-water, taking care that he does not clasp his sucker-covered arms around our hands as we perform the operation.

Small and comparatively innocent is this *Octopus punctatus* Gabb, for he does not measure more than two feet from tip to tip of arms, but even he, could he get our finger between the parrot-like jaws which lie deep down inside the umbrella, would make us think we had caught a tartar. This, and the six others we see before our excursion is ended, are all baby Octopi, but in the market of San Francisco occasionally hangs a "devil-fish" of the same species with arms from five to six feet long, an uncanny object when dead, and one to be avoided when alive. Not long ago in the Straits of Fuca, near Victoria, an Indian woman was drowned by an Octopus probably of this species. John Keast Lord tells us that the Indians of Vancouver's island fish for them with a spear and a knife, each at the end of a pole some fifteen feet long. Driving the spear into the body they hold the Octopus at a safe distance while, wielding the knife with the other hand, they sever one by one the formidable arms, whose double rows of suckers would, could they but once lay hold, never leave their victim till he was brought within reach of the jaws. An old Frenchman who comes along with one of these octopi impaled on a stick tells us he is taking it for a treat to his wife and family. Finding a second, he grows ecstatic as he pounds its head (as he calls the body) on a rock, apostrophizing it meanwhile in terms of mingled dislike and contentment. They surely must be good. Frenchmen eat them, Spaniards think "gibiones" a delicacy, Italians do not disdain them, Chinamen devour them; why not Anglo-Saxons? But the Anglo-Saxon, and the Celt also, have much to learn yet in the way of food, and must surely learn much as the world becomes more crowded, unless they wish to be "improved" away from the face of the earth.

We have now rounded the point, and reached the valley beyond. There is the usual sandbar, backed by a small lagoon, from which a rillet flows across the beach. Here we leave the shore and ascend the hill, gathering the wild flowers as we go. Patches of

Lupinus micranthus and *Orthocarpus erianthus* fleck the hillside with blue and white, but the show of the flowers is not on this southern side, exposed to the rough westerly blasts of the Pacific as they sweep through the valley, but on the moister and comparatively sheltered north-eastern slope. One of the most abundant of flowers, here and in the whole vicinity of San Francisco, is the *Œnothera primuloides*, a stemless plant with yellow blossoms, each on its own peduncle, reminding us of the primrose. Another flower, plentiful on this hill, but very local in its distribution, is the purple and white *Collinsia bicolor*, belonging to the same order with the Mimuli, two kinds of which, *Mimulus luteus* and *M. glutinosus*, may be found near by, the former by the water-courses and in the wet places which abound after the heavy rains, the latter on the dry hillsides. The great yellow daisy-like *Layia platyglossa*, with its ray-florets tipped with cream-color, from which it has earned the name of "tidy-tips," is to be seen here and there, but does not show as it does across the bay, at Oakland, where whole fields are golden with its blossoms.

The *Eschscholzia californica* is here, of course; there is not a month in the year when it cannot be found, but now it is in its glory, its gorgeous orange petals inducing every urchin that comes along to gather the "lilies," as he calls them.

Another of the poppy-tribe the little "cream-cup," *Platystemon californicum* Bentham, may be found if looked for, for it is modest, unlike poppies in general. *Orthocarpus* is a very conspicuous genus in California generally, on this hill-side we gather, besides the white one already mentioned, the purple and yellow *O. castillejoides*, and the tiny-flowered *O. pusillus*.

Nemophila insignis is almost out of blossom, yet we find a few, and among the loose stones high up the hill we find one of its rarer relations, the rough, almost prickly, *Phacelia loasifolia* Torrey. The more common Phacelias, *P. circinata*, with its coarse foliage and cat's tail-like curled flower-spikes, and the more delicate *P. tanacetifolia*, we do not meet with in this ramble.

The rose order is represented only by one plant, the humble *Acæna trifida*, a near relation of the *Sanguisorba* or Burnet.

Almost the only shrubs to be found are a dwarf oak and the poison oak, *Rhus diversiloba* Torrey-Gray, the latter unfortunately only too common, as we find to our cost next day, when our wrists inflame and become covered with the pustules produced

by its juice. It lurks in every bunch of tall herbage, its glossy, green leaves and greenish racemes of flowers mingled with the vetches, phacelias, and other innocent plants in so intricate a way that it is almost impossible to collect them without contact with it. On the hillsides it is low and straggling, its roots running to great distances under the surface, and throwing up stems and leaves in unexpected places; in the copses it forms large bushes, alone or mingled with other shrubs; but in the forests it is a huge climber, mounting the tall pines and firs and strangling them. When a climber, its leaves are much larger and lighter in color, and it is usually believed to be a different plant from its humbler brethren of the meadows, being distinguished as Poison ivy.

There is but little of animal life on the down, for there is no shelter for birds, or thicket-loving mammals. The ground-squirrel, *Spermophilus beecheyi*, is present here as it is in every green field and every hill-side round the bay.

Man has killed off its natural enemies, the smaller carnivorous mammals and the birds of prey, and has planted the once wild country with seeds that suit its appetite, so that it flourishes and increases in spite of poison, traps, and guns, till it is a terrible nuisance to every farmer. The only other wild quadruped we find is not a mammal, but a lizard. We come upon two individuals among a heap of stones, and after quite a chase, capture one, a fine fellow, in a livery of reddish and yellowish-brown mixed with darker tints. It has quite a long tail as it is, yet it has evidently been mended at the tip. It is *Gerrhonotus grandis*.

We are now at the foot of the hill, close to the Chinese colony, from whose huts arises a most unsavory smell of rotting fish. Here we have John Chinaman at his lowest, dwelling in squalid huts with ground for the floor, yet even here his virtues of persistent industry, economy, and quickness to lay hold of everything which can be turned to account, are clearly evident. All the day these fishers work, their unwieldy flat-bottom boats are scattered in all directions, and their nets are spread for big and little fish alike, spite of laws against the destruction of fry. The little fish disdainfully thrown on the shore and left to rot by the Italian fisherman, are by the Chinese gathered carefully up and dried. While the white laborers assemble by thousands to hear incendiary speeches, with occasional adjournments to the nearest saloon, John calmly works on. If the capitalist employs

him, he does his duty; if left without employment from others, he finds out work for himself; he runs a laundry; he fishes; he peddles vegetables; he hunts up rags and bones; he turns gardener, choosing all the little valleys between the sand hills, irrigating them, and raising large crops where the white man raised nothing; all the time serenely confident that as long as his prices are lowest, he will find plenty of customers, some of the best of them among the very men who shout so loudly "the Chinese must go." Truly, unless the government promptly pass some law to restrain the Chinamen from free access to these shores, the poor white man even if sober and industrious, will soon find life growing very hard, for what chance has he, with his ideas of comparative luxury in house, food and clothing, probably a wife and family, and often some intellectual tastes also, against a rival who lives in an unfloored hut, feeds on rice, stuffs his blouse with hay when the weather is cold, has only himself to keep, and never troubles his head about literature, science, or politics, yet all the time keeps a keen eye on the main chance, earning and keeping every cent he can, and scarcely ever resting from labor except for the needful sleep.

Note.—In my last paper I referred the Planorboid shell found in Mountain lake, S. F., to the genus *Helisoma*, but I find it to be a genuine Planorbis. The tiny little flat shell from the same pond is *Menetus opercularis*. Prof. Verrill has informed me that the small starfish mentioned as probably new is the *Asterias equalis* of Stimpson. It is rare and local in this neighborhood.

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SOME CHARACTERISTICS OF THE CENTRAL ZOÖ-GEOGRAPHICAL PROVINCE OF THE UNITED STATES.[1]

BY A. S. PACKARD, JR.

IN recent studies on the extent of the native breeding places of the Rocky Mountain locust, my attention, while in the field and afterwards in working up some of the results then obtained, has been directed to some of the faunal characteristics of the Central province; my own observations bearing especially on the distribution of certain insects and especially the Phyllopod Crustacea, whose distribution west of the Mississippi presents some points of considerable interest.

[1] Read at the last April meeting of the National Academy of Sciences, Washington.

The first attempt to divide the United States as a whole into zoölogical provinces was in 1859, by Dr. LeConte, in his "Coleoptera of Kansas and Eastern New Mexico (Smithsonian Contributions, 1859)." He divided the Coleopterous fauna of the United States into three great zoölogical districts, distinguished each by numerous peculiar genera and species, which, with but few exceptions, do not extend into the contiguous districts. He named them the Eastern, Central and Western divisions; so that to him is due the credit of first distinguishing the Central province.

In 1866, Prof. Baird,[1] from a study of the avifauna of the United States, concluded that "the ornithological provinces of North America consist of two great divisions of nearly equal size in the United States, meeting in the vicinity of the 100th meridian, the western half divisible again into two, more closely related to each other than to the eastern, though each has special characters. These three sections form three great provinces to be known as the western, middle and eastern; or those of the Pacific slope; of the great basin, the Rocky mountains and the adjacent plains; and of the fertile plains and region generally, east of the Missouri."

In 1871, Mr. J. A. Allen,[2] divided the avifauna of the United States into two provinces, the eastern and western, the latter embracing the Pacific coast. (Since this paper was read Mr. Allen's late essay has appeared, in which he adopts Prof. Baird's division into three provinces. The geographical distribution of the mammalia, etc. Bulletin of Hayden's U. S. Geographical and Geological Survey of the Territories, May 3, 1878).

In 1873,[3] Mr. W. G. Binney published a map of the distribution of our land shells, dividing the molluscan fauna into the Eastern, Central and Pacific provinces.

In 1875, Prof. E. D. Cope in his check list of North American Batrachia and Reptilia[4] divided the Nearctic realm of Sclater into the Austroriparian, Eastern, Central, Pacific, Sonoran and Lower Californian regions. He remarks that "the Pacific region is nearly related to the Central, and, as it consists of only the narrow district west of the Sierra Nevada, might be regarded as a sub-divi-

[1] American Journal of Science and Arts, January and March, 1866.
[2] Bulletin of the Museum of Comp. Zoology, April, 1871.
[3] Catalogue of the Terrestrial Molluscs of North America.
[4] Bulletin U. S. Nat. Mus., Washington, 1875. Bull. Mus. Comp. Zool., 1873.

sion of it. It, however, lacks the mammalian genera *Bos* and *Antilocapra*, and possesses certain peculiar genera of birds, as *Geococcyx*, *Chamæa* and *Oreortyx*. . . . There are some genera of reptiles, *e. g. Charina*, related to the Boas, *Lodia*, *Aniella*, *Gerrhonotus* and *Xantusia*, which do not occur in the central sub-region. There are three characteristic genera of Batrachia, all Salamanders, viz: *Anaides*, *Batrachoseps* and *Dicamptodon;* while the eastern genera *Plethodon* and *Diemyctylus* reappear after skipping the entire central district." Cope adds that "the fresh-water fish fauna is much like that of the central district in being poor in types." Cope's Sonoran region is evidently a northward extension of the Mexican fauna, which sends its outliers into southern Arizona, Utah and New Mexico, and is not to be taken into account in discussing the faunal provinces of the United States alone.

In 1876, Wallace in his "Geographical Distribution of Animals," divided the Nearctic region into four sub-regions, viz: the Californian, Central or Rocky mountain, Alleghanian and Canadian. His Central sub-region extended to Lat. 25° N.

It will be seen from this review that by general consent the fauna of the Pacific slope is on the whole regarded as belonging to a separate province from that of the Rocky Mountain plateau, whether we regard the mammals, birds, reptiles, amphilia, Coleoptera or land shells.

Botanically, as observed by those who have traveled across the plains to California, the flora of the great plains is quite different from that of the Eastern States, and the Pacific flora is as distinct from the central flora. This has been clearly shown by Sir J. D. Hooker and Prof. Asa Gray in their preliminary notices of the results of their botanical researches in connection with Dr. Hayden's U. S. Geological Survey of the Territories.

In traveling last summer, in pursuance of the work of the U. S. Entomological Commission, I passed rapidly over a large area of the Central province lying north of the fortieth parallel, including Colorado, Wyoming, Northern Utah, Western Idaho, Central and Northern Montana, and was thus enabled to observe in a superficial way the general features of the flora and fauna nearly up to the British line. I was impressed with the resemblance of Central and Northern Montana to Northern Utah, the insect-fauna being apparently nearly identical. Doubtless this insect-fauna extends

northwards into the Upper Saskatchewan valley as far as the southern limit of trees, there being much less internixture with Canadian forms than might be expected. Then crossing the Sierra Nevada, and going overland to Oregon, I was able to trace the gradual passage of the Californian insect-fauna into the Oregonian, with some Canadian forms; and by passing up the Columbia river to Wallula, here as well as at Reno in Nevada, to perceive the great differences between the fauna of the Pacific slope and that of the plains and deserts of the Central province.

In briefly reviewing the different orders of insects, other than Coleoptera,which have been so fully elaborated by Dr. LeConte, and certain groups of Crustacea, we will begin with the *Hymenoptera*, and point out a few characteristics distinguishing the Central from the Pacific provinces. In 1865 and 1866 a large number of Coloradian fossorial Hymenoptera passed under the writer's hands, Mr. Cresson having previously described from this material a large number of Coloradian Hymenoptera of all families. The richness of the hymenopterous fauna of Colorado struck me, and I was impressed with its distinctness from that of the Eastern States. I have seen few of these forms from California. Among the family of ants (*Formicidæ*), there is one form characteristic of the plains which does not occur on the Pacific slope. This is the *Pogonomyrmex occidentalis* (Cress). I have seen its large hills at Brookville, Kansas, and observed them in Colorado and Utah and in Reno, at the base of the Sierra Nevada, but not west of that point. It ranges, according to Mayer, south into New Mexico, and San Luis valley, Colorado. Its nest forming large elevations in cleared spaces sometimes six or eight feet in diameter, is one of the characteristic sights on the plains.

Among the *Lepidoptera*, family *Bombycidæ*, there are several forms peculiar to the central district, notably the genus *Dirphia* (Coloradia), *Eulecophaeus*, *Gloveria* (*Mesistesoma*), *Hemileuca Juno* and *Hera*, and *Platysamia gloverii*. The family is feebly represented in the Central province, but richly so by numerous species on the Pacific slope, which do not appear east of the Sierra Nevada.

The *Phalænidæ*, or geometric moths, are richly developed in the Pacific province, and but poorly in the Central province, owing to the absence of deciduous trees; of those found in the latter some occur west of the Sierra Nevada, and some are peculiar to the plains and Rocky mountains.

Of the *Orthopera* there is a large number of species peculiar to the plains which I did not observe in the Pacific States; of these, *Caloptenus spretus* is thoroughly characteristic of the Central province. It does not occur in the Pacific and only breeds temporarily in the Eastern province, and its natural limits define well those of the province itself. It ranges up to lat. 53° N. on the North Saskatchewan and south to Southern Utah and Colorado. The exact limits of its distribution are given in the First Annual Report of the U. S. Entomological Commission.

While we are still ignorant of the distribution of insect life between the hundredth meridian and the Pacific ocean, there seems good reason, from what we do know, and from the great differences in the flora, and the soil and climate, especially the rainfall east and west of the Sierra Nevada, to regard this lofty range as the general point of separation defining two grand zoölogical provinces. Many groups of insects abounding west of the mountains do not occur east, except in isolated cases. Of a number of Myriopods found on the Pacific coast none occur east, and so of the Arachnida so far as known, and Dr. Thorell, who has worked up some of the spiders of Colorado, was struck by the general similarity of some forms to those occurring in the plateau of North-eastern Asia. Among the insects there are a few Pacific forms which closely resemble European species, and which are not represented east of the Sierra Nevada. It should be borne in mind, however, that the Sierra Nevada does not present an absolute barrier, as a considerable number of species occur on each side of it, and it is well known that the Rocky Mountains are but a slight barrier to the distribution of the animals on either side, the fauna of Colorado, Northern Utah, Wyoming, Montana and Idaho being quite homogeneous, and the fauna of these Territories the same on each side of the high mountain ranges traversing them.

Among the fresh-water Crustacea the *Astaci* of the Pacific slope, as is well known, belong to the European genus *Astacus*, those east of the Sierra Nevada to the genus *Cambarus*, which is so richly developed in the Eastern provinces, especially in the Mississippi valley.

The distribution of the fresh-water *Phyllopoda* is of peculiar interest. The family *Apodidæ* is restricted to the Central province: none are found in the Mississippi valley, and none in Cali-

fornia. Of the four species of *Apus* all inhabit the Central province; *Apus æqualis* lives on the plains of the Rocky mountains, and also at Matamoras, in Mexico. It is a curious fact that *Apus lucasanus* Pack., not only occurs at Cape St. Lucas, Lower California, but is also an abundant species at Ellis, Kansas. This is a parallel case to the presence of certain birds at Cape St. Lucas which, as observed by Prof. Baird, belong to the Central rather than to the Pacific province. Of the genus *Lepidurus* there are two forms (*L. couesii* and *L. bilobatus*) characterizing the plains. *L. couesii* occurs in Northern Montana, and is allied to a recently described Lepidurus from Archangel, Russia, according to Lilljeborg.

The eastern limits of the Central province extend to near the 97th meridian in Kansas and Nebraska, according to the writer's observations.

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THE REPORT OF THE COMMITTEE OF THE AMERICAN ASSOCIATION OF 1876 ON BIOLOGICAL NOMENCLATURE.

BY E. D. COPE.

IN the year 1842 the British Association for the Advancement of Science took into consideration the question of zoölogical nomenclature, and through a committee made a report, which embodies a series of recommendations in the form of rules. In 1863 another committee of the British Association revised these rules and reprinted them with various additional recommendations. This report was republished in this country with a few additional suggestive notes by Prof. A. E. Verrill, in 1869.[1] Since that date the question has been discussed by the American entomologists Scudder, Edwards and LeConte.

The rules issued at the earlier periods above mentioned dealt largely with etymological and literary questions, while admitting in general terms the necessity of observing the law of priority of date. The energy of some of the resurrectionists of obsolete works in bringing to light old names, however, soon drew attention to the importance of ascertaining the real nature of priority of date; and the close coincidence of date of some modern publications, has brought up the question from another side. The

[1] Amer. Jour. Sci. and Arts, July.

entomologists first began to handle the subject critically, the most practical article with which I am acquainted being that of W. H. Edwards.[1]

In order to establish a basis of definite action in this matter, the American Association for the Advancement of Science at its meeting in Buffalo, in 1876, appointed a committee "to obtain an expression of opinion from the working naturalists of America in regard to the nature of a set of rules for facilitating the decision of questions relating to nomenclature," etc. The committee consisted of Capt. Wm. H. Dall, of the U. S. Coast Survey, and the results of his work are now given. To my own mind the method pursued by Capt. Dall was excellent, and the results are very satisfactory as displaying a degree of unanimity among American naturalists so complete as to constitute their opinions, as embodied in Capt. Dall's report, a set of rules which no one can safely disregard on the one hand, or hesitate to follow on the other.

Capt. Dall's prefatory remarks are as follows:

In accordance with the understanding and resolutions of the Section, by which this duty devolved upon him, your Reporter prepared a circular which was printed under the supervision of the permanent secretary and circulated by the Smithsonian Institution, a copy of which is appended to this report.

The circular was sent to all who, within the last five years, might be included under the designation of publishing naturalists, and of whom the address could be obtained. This list included about eighty-five names, from a number of which (for various reasons) a response was hardly anticipated. They were used, however, in order that the fullest opportunity might be afforded to all those who might desire to express an opinion.

The responses received to date (August 14, 1877), are forty-five in number. While a few honored names, to whose views all would attribute due weight, are not on the list, yet it includes most of those whose contributions are familiar in the Proceedings of American Scientific societies, and an unquestionable majority of the best working naturalists of the country. The views of several of those from whom no response was received, have been incorporated in the appendix by means of citations from their works.

The queries contained in the circular relate chiefly to certain points, concerning which a diversity of opinion has existed among naturalists; the general principles of nomenclature not being in question. The responses are divided into affirmative, negative

[1] Canadian Entomologist, February, 1873.

and doubtful, while in individual cases some queries received no response. The answers classified as doubtful, comprise those which by their tenor indicated that the purport of the particular query had not been clearly understood, and some in which the person replying avowed his inability to express a preference for any one of several modes of proceeding.

The gratifying unanimity which is exhibited in the responses to certain of the more important and clearly defined questions at issue, indicates that a thorough study of the more complicated questions by the light of the general principles of nomenclature, would result in a practical agreement on the part of American naturalists in relation to nearly all the matters in debate.

It is evident from the responses of naturalists, that their opinion is generally adverse to any attempt to limit, by arbitrary rules, the right of publication in the most convenient direction, and against any statute of limitations in regard to scientific names. This seems to be in accord with the principles of justice, equity and general usage in nomenclature, though at times inconvenient in its results. It may be confidently expected that the majority of authors, when their attention has been drawn to it will, for their own interest as well as that of science, avoid in future publications, the methods (or want of method) which in the remote past sowed so many germs of present difficulty.

The circular with replies is preceded by the following note by Capt. Dall:

NOTE.

The question with which the working naturalist is most frequently brought face to face—and in the decision of which so much trouble is experienced and such diverse opinions are elicited—are chiefly those which involve the right of any one of several names to be considered as properly proposed and entitled to take precedence of others, provided its priority in time of application be established.

The rule that names (otherwise unexceptionable) which are prior in date, are to be accepted in nomenclature to the exclusion of all others, is conceded by all naturalists.

The rules recommended by the Committee on Nomenclature of the British Association for the Advancement of Science, have been generally adopted; though in certain details they are regarded by many naturalists as defective. Nevertheless they have largely contributed to that uniformity which is so desirable in the matter of nomenclature.

It has been thought that a similar recommendation on the part of the American Association might reach many who are not conversant with the British rules and tend to produce in the works of the rising generation of American naturalists a similarly beneficial agreement.

The differences of opinion which have arisen, are chiefly in matters of detail and intrinsically of very slight importance.

One of the most serious in its effect upon nomenclature is that in regard to what names shall be considered as really binomial; another as to what is necessary to definitely establish a name in order that if prior to any other it may be accepted as properly proposed; and most of all as to the date to be adopted as that of the beginning of binomial nomenclature. This latter question, as to facts, on the authority of De Candolle, stands as follows:

A series of rules for nomenclature was to some extent foreshadowed by Linnæus in his *Fundamenta Entomologia* of 1736. These rules were first definitely proposed in the *Philosophia botanica*, which appeared in 1751. These rules, however, related almost exclusively to the generic name or *nomen genericum*. In 1745, he had employed for the first time a specific name (*nomen triviale*) composed of one word, in contradistinction to the polynomial designation of a species (*nomen specificum*) which was previously the rule among naturalists. That which now seems the most happy and important of the Linnæan ideas, the restriction of the specific name as now understood, seems to have been for a long time only an accessory matter to him, as the *nomina trivialia* are barely mentioned in his rules up to 1765.

In 1753, in the *Incrementa botanices*, while expatiating on the reforms which he had introduced into the science, he does not even mention the binominal nomenclature. In the *Systema Naturæ*, Ed. X, 1758, for the first time the binominal system is consistently applied to all classes of animals and plants (though it had been partially adopted by him as early as 1745), and hence many naturalists have regarded the tenth edition as forming the most natural starting point. The system being of slow and intermittent growth, even with its originator, an arbitrary starting point is necessary. In the twelfth edition (1766–68), numerous changes and reforms were instituted, and a number of his earlier specific names were arbitrarily changed. In fact, Linnæus never seems to have regarded specific names as subject to his rules.

The last was recommended by the British Committee as the starting point. They have since, however, receded to the extent of admitting to recognition some ichthyological works printed between the dates of the tenth and twelfth editions.

The circular with the appended replies is as follows:

QUESTIONS TO WHICH AN ANSWER IS DESIRED.

I. What date shall be taken as the commencement of the binomial era in nomenclature? For Ed. X, 18. Ed. XII, 17. 1736, 1. Botanists, 1753, 2. No answer, 7.

II. Shall phrases composed of two words which may appear in the publications of naturalists whose works

preceded, or who did not in such works adopt the binomial system of nomenclature, be considered as binomial names? No, 32. Yes, 5. No answer or doubtful, 8.

III. If so, shall the first word of the said phrase be entitled to recognition as a generic name? No, 32. Yes, 5. No answer or doubtful, 8.

IV. If an author has not indicated his adoption of the binomial system by discarding all polynomial names in a given work, are any of his names therein entitled to recognition otherwise than in bibliography? No, 18. Yes, 18. Doubtful, 4. No answer, 5.

Example. Da Costa in his work on the Conchology of Great Britain, varies from binomial to polynomial in his designations of species, and some of his "generic" names contain two or three words, while others apparently conform to the Linnæan system. Should any of these names be retained?

V. Does the reading of a paper before a scientific body constitute a publication of the descriptions or names of animals or plants contained therein? No, 39. Doubtful, 2. Yes, 4.

VI. Is a name in the vernacular of the publishing author, or a vernacular rendering from a classical root unaccompanied by a Latin or Greek form of the name, entitled to recognition except in bibliography? No, 36. Doubtful, 2. Yes, 4. No answer, 3.

VII. Is a name applied to a group of species without a specification of any character possessed by them in common (that is, without any so-called generic diagnosis or description), entitled to recognition as an established generic name by subsequent authors? No, 38. Doubtful, 3. Yes, 3. No answer, 1.

VIII. Is a generic name applied to a single (then or previously), described species without a generic diagnosis or description of any kind, entitled to recognition as above, by subsequent authors? No, 37. Doubtful, 3. Yes, 4. No answer, 1.

IX. Is a name, when used in a generic sense, and otherwise properly constituted, subject to have its orthography changed by a subsequent author, on the ground that a proper construction from its classical roots would result in a different spelling? No, 21. Doubtful, 3. Yes, 19. No answer, 2.

X. If the previous question be answered in the affirmative, it may be further enquired whether an author has a right to assume that a given name is derived from classical roots, when the author of the name did not

so state, and on this assumption to proceed to change the said name to make it agree with the assumed proper construction in any case? and especially when by the asserted reformation the generic name becomes identical with one previously proposed for some other animal or plant, and hence will fall into synonymy? No, 25. Doubtful, 2. Yes, 6. No answer, 12.

Example. Schumacher described a genus which he called *Paxydon*, giving no derivation. A subsequent author described a genus *Pachydon*, giving the derivation. A third writer assumed that Schumacher's name had the same derivation as *Pachydon*, and that both, if correctly written, would be *Pachyodon*. The last mentioned then proposed a new name for *Pachydon*, which he had thus made to appear preoccupied. Was this allowable? No. 26. Doubtful, 3. Yes, 8. No answer, 8.

XI. Should a generic name, otherwise properly constituted, but derived from the specific name of its typical species, or similar to that of one of the species included under it, be rejected on that account? No, 40. Doubtful, 4. Yes, 1.

Note. It is proper to state that this is an important question, since Linnæus himself, and others, formed many generic names in this manner, and a large number of such names are currently accepted, especially in botany and among vertebrate animals.

XII. Shall a subsequent author be permitted in revising a composite genus (of which no type was specified when it was described) to name as its type a species not included by the original author of the genus in that latter author's list of species given when the genus was originally described? No, 37. Doubtful, 2. Yes, 5. No answer, 1.

Example. Linnæus described a genus *Chiton* with a very few species. After many species had been described by others, a later author divided the genus into a number of genera, and reserved the name of Chiton (restricted) for a species described many years after the death of Linnæus and belonging to a section of the *Chitonidæ* unknown to Linnæus; while to the Linnæan chitons he gave new appellations.

XIII. When an old genus without a specified type has been subdivided by a subsequent author, and one of the old species retained and specified to be the type of the restricted genus bearing the old name,—is it competent for a third author to discard this and select another of the original species as a type, when by so doing changes are necessitated in nomenclature? No. 39. Doubtful, 4. No answer, 2.

XIV. Shall an author be held to have any greater control over or greater privileges with relation to names of his own proposing, after the same have been duly published, than any other subsequent author? No, 40. Doubtful, 2. Yes, 2. No answer, 1.

XV. For instance, when an author describes a genus and indicates a species as its type, is it allowable for him subsequently to substitute any other species as a foundation for his genus, or to use the original type as a foundation for another new genus? No, 38. Doubtful, 1. Yes, 2. No answer, 4.

XVI. If an author describes a genus and does not refer to it any then or previously described existing species, can the genus be taken as established? No, 33. Doubtful, 7. Yes, 1. No answer, 4.

XVII. If an author applies a specific name to an object without referring it to some then or previously described genus, is the specific name entitled to recognition by subsequent authors? No, 33. Doubtful, 4. Yes, 7. No answer 1.

XVIII. When a generic name has lapsed from sufficient cause into synonymy, should it be thenceforth entirely rejected from nomenclature? or should it still be applicable to any new and valid genus? Reject, 19. Accept, 23. Doubtful, 1. No answer, 2.

XIX. Should a name which has been once used in one subkingdom, and has lapsed into synonymy, be considered available for use in any other if not entirely rejected from nomenclature? No, 20. Doubtful, 1. Yes, 18. No answer, 6.

XX. Should a name be liable to be changed or a later one substituted for it, if the original be supposed to be inapplicable or contradictory of the characters of the species or genus to which it was applied? No, 28. Doubtful, 3. Yes, 13. No answer, 1.

Example. A fish without teeth was named *Polyodon*, which name had come into use; when a later author substituted *Spatularia* on the ground that *Polyodon* was inapplicable.

XXI. Is it advisable to fix a limit of time, beyond which a name which had been received without objection during that time shall be held to have become valid, and no longer liable to change from the resuscitation of obsolete or uncurrent but actually prior names? No, 28. Doubtful, 1. Yes, 13. No answer 3.

XXII. If so, what shall this period be? No answer, 35. The others range from 10 to 100 years.

XXIII. Should it be permitted to alter, or replace by other and different appellations, class, ordinal and family names, which owing to the advance of science and consequent fluctuation of their supposed limits have become uncharacteristic? Yes, 30. Or should these

also be rigidly subject to such rules of priority as might be determined on for generic or specific names? No answer, 4. Yes, 11.

XXIV. Should or should not absolute certainty of identification be required before it be permissible to reject a modern and generally adopted name in favor of a prior but uncurrent designation? Yes, 38. Doubtful, 2. No answer, 5.

Note.—Many of the old descriptions of species sufficient for identification when few species were known, are entirely insufficient at the present day to distinguish between allied species. Should, therefore, a modern specific name with a recognizable description be made to yield to an older name unless the identification can be made beyond any cavil?

XXV. Is it desirable to adopt any classification of periodical literature by which certain exclusive channels for publication of descriptive papers in natural history shall be designated for use by authors who desire to secure the rights of priority for new names proposed by them? No, 26. Desirable but impracticable, 9. Yes, 8. No answer, 2.

Note.—An affirmative answer will imply that names which may be proposed through other than the designated channels, after the latter shall have been decided upon, shall not be entitled to recognition in questions of priority.

XXVI. Is it desirable to adopt any analogous rule in relation to the character or extent of distribution of any independent publication or pamphlet to which it must conform, on pain of losing its right to recognition? No, 21. Desirable but impracticable, 10. Yes, 14.

Note.—If the answer to either or both of the two preceding questions be affirmative, a note specifying the nature of the proposed classification or restrictions may be appended to this list.

XXVII. Should a series of rules be recommended for adoption by the Association, would you be guided by these recommendations in cases where they might not agree with your own preferences? Yes, 29. Yes, with reservations, 15. No, 1.

LIST OF NATURALISTS FROM WHOM REPLIES TO THE CIRCULAR HAVE BEEN RECEIVED.

J. A. Allen, Museum of Comparative Zoölogy.
W. G. Binney, Burlington, N. J.
Richard Bliss, Jr., Cambridge, Mass.
Dr. Thomas M. Brewer, Boston Society of Natural History.
Dr. P. P. Carpenter, McGill University.
S. F. Clark, Johns Hopkins University.
T. A. Conrad, Philadelphia Academy of Natural Sciences.

Dr. J. G. Cooper, California.
Prof. E. D. Cope, Philadelphia.
W. H. Dall, Smithsonian Institution.
Prof. J. D. Dana, Yale College.
Dr. J. W. Dawson, McGill University.
W. H. Edwards, West Virginia.
S. W. Garman, Museum of Comparative Zoölogy.
Dr. T. N. Gill, Smithsonian Institution.
Dr. Asa Gray, Harvard University.
A. R. Grote, Buffalo Academy of Sciences.
Dr. Herman Hagen, Museum Comparative Zoölogy.
Dr. Geo. H. Horn, Philadelphia.
Prof. Alpheus Hyatt, Boston Society of Natural History.
Ernest Ingersoll, New York.
W. P. James, Cincinnati, Ohio.
Prof. D. S. Jordan, Indiana.
Dr. J. L. LeConte, Philadelphia Academy of Natural Sciences.
Dr. Joseph Leidy, Philadelphia Academy of Natural Sciences.
Dr. James Lewis, Mohawk, N. Y.
Theodore Lyman, Museum of Comparative Zoölogy.
T. L. Mead, New York.
S. A. Miller, Cincinnati, Ohio.
Dr. A. S. Packard, Jr., Peabody Academy of Sciences.
F. W. Putnam, Museum of Comparative Zoölogy.
Prof. C. V. Riley, U. S. Entomological Commission.
Prof. C. Rominger, State Geologist, Michigan.
Dr. J. T. Rothrock, University of Pennsylvania.
S. H. Scudder, Cambridge, Mass.
Prof. N. S. Shaler, State Geologist of Kentucky.
Herman Strecker, Reading, Pa.
Prof. Cyrus Thomas, U. S. Entomological Commission.
Geo. W. Tryon, Jr., Philadelphia Academy of Natural Sciences.
P. R. Uhler, Peabody Institute, Baltimore.
Sereno Watson, Harvard University.
Dr. C. A. White, U. S. Survey of the Territories.
J. F. Whiteaves, Palæontologist to the Canadian Geol. Survey.
Prof. R. P. Whitfield, Amer. Museum of Natural Hist., N. Y.
Dr. H. C. Yarrow, United States Army.
Two accidentally unsigned.

THE ANCIENT PUEBLOS, OR THE RUINS OF THE VALLEY OF THE RIO SAN JUAN.[1]

BY EDWIN A. BARBER.

PART I.

AS early as the sixteenth century, about the year fifteen hundred and thirty-nine (1539), some of the deserted cities of a pre-historic people (which have since been found to be so numerous all through a portion of the Pacific slope of North America, were observed by several of the Spanish expeditions which had penetrated into the country north of Mexico, known then under the general name of New Mexico, including the present Territory of Arizona. Many of the towns of this section were at that early date found to be in ruins, presenting every indication of a great antiquity; while others, which now lie mouldering in the cañons of the far west, were found by these old explorers, at that time, to be occupied. The course of the Spaniards, headed by Coronado and others, lay to the south of the San Juan river, passing through the valley of the Rio Grande del Norte, on the Atlantic slope, the seat of the so-called Puéblo Indians, and westward through *Zuñi*, then known as *Cibola*, and so on to the ancient province of *Tusayan*, or our modern *Moqui*, on the Pacific or western slope of the Rocky mountains.

Until the past year or so, however, the great stretch of country lying west of the Range, including portions of Southern Colorado and Utah, and much of Arizona and New Mexico, was entirely or almost unknown. Our only knowledge of it consisted in the inconclusive and contradictory reports of expeditions or individuals which had crossed the borders of the ancient domains; and from their casual discoveries we were made aware of the existence of a multitude of ruins which extended as far north as the thirty-eighth degree of latitude. Unsatisfactory as this information was, it served to arouse a latent interest and to create a thirst for more facts among cultured circles, and opened a new and vast field for scientific research. During the summer of 1874 a pioneer corps was sent out by Prof. F. V. Hayden, of the United States Geological Survey, to photograph any ancient structures which might be discovered in South-western Colorado and South-eastern Utah, thus preparing the way, as it were, for a

[1] Extracts from a paper written by the author and read before the *Congrés des Américanistes*, at Luxembourg, in September, 1877, with additions.

more thorough exploration of this country during the next season. The results of this expedition were so flattering, and the report of the photographist, Mr. Wm. H. Jackson, so full of interest, enthusiasm and valuable information, that several parties were ordered to the field in the summer of 1875.

In passing through this portion of the west, the traveler is first impressed with the great extent of the territory over which the ancient remains occur. Generally speaking, they occupy the great valleys drained by the San Juan river and its tributaries, the Rio Grande del Norte, and the Colorado of the west, covering an area of probably 200,000 square miles.

The communities, it is evident, sprung up along the banks and valleys of the once well-watered streams, and as many of these are now entirely dry, this fact would suggest the idea that the entire character of the country has undergone a great physical change. A calculation as to the time required to effect such an alteration might assist us in arriving at the approximate age of these remains. On further investigation, it will be discovered that not only the larger water-supplies have failed since these structures were occupied, but the lesser ones also, in the form of springs, reservoirs and lakes; because in the majority of instances to-day, not a drop of moisture exists within a radius of twenty-five or thirty miles from many of the more important ruined villages. The entire country must at one time, and during the prosperity of the race, have been well-watered and fertile. The beds of the parched flood-washes must formerly at times have conveyed the waters of overflowing torrents, as everything yet indicates, and the valleys were productive of corn and the indigenous vegetables, for the very farms and corn-fields are still traceable in the river-bottoms, laid out in rectangles, and well defined by the dense growth of a hardy species of Helianthus. A great blight must have swept over the land, scorching and parching every green thing, and lapping up every particle of moisture, transforming the luxuriant valleys into deserts of rocks and sand.

The ruined buildings of this portion of the west may be arranged under two general heads: First, *Valley Remains*; Second, *Cliff Houses.*

The former class consists of those which were built on level ground, either in the river-bottoms or at the feet of ravines and cañons; and these may be subdivided into two classes: First,

Puéblos or *towns*, and secondly, *Defensive structures.* Valley ruins were by far the most extensive, sometimes covering miles of bottom land, in an almost unbroken series of huge buildings, but they were not nearly so numerous as the cliff houses. The ancient tribe or tribes congregated together along the water-courses for sociability (man being a gregarious animal) and for mutual protection.

The cliff-houses are of three sorts: First, *dwellings*; secondly, *watch-towers;* and, thirdly, *caches* or *store-houses.* These were built among the sandstone bluffs and crags of the cañons; at every altitude and in every conceivable position. From the base of an almost vertical wall, up to the very summit of the mésa, a distance, sometimes of over a thousand feet, these human eyries are perceivable, perched sometimes on almost or quite inaccessible shelves, or on the very pinnacle of some isolated bowlder, whose sides look down perpendicularly for hundreds of feet. In every imaginable condition of location, they existed and the beholder is impressed with a feeling of awe, in simply gazing on the works of the intrepid architects; on the places where human beings once dwelt; places which now are wholly out of reach of the explorer. The walls of the buildings are sometimes built along the ledges of rock, on the horizontal foot-holds which occur among the cliffs; but far more frequently, the natural caves and hollows (formed by the erosion of the atmosphere) were converted into dwelling places.

One of the most noticeable features of all of these cliff-structures, was the evident desire on the part of their proprietors to conceal them from view, and this is shown in the prevailing custom of building in secluded spots, and in imitating, as accurately as possible, in the architecture, the general appearance of the surrounding rocks. In many cases, indeed, this simulation of texture and color has been rendered so perfect, that the ruins are entirely over-looked, unless brought to view through a field-glass.

Clearly, then, there must have been a cause for these precautions. The empire was invaded by a foreign foe, and the people gradually forced southward; fleeing to the rocks at first, for refuge, but finally retiring before the advance of a powerful and cruel enemy. This fact is made more evident by the presence of great numbers of arrow-points and war-like weapons, in the

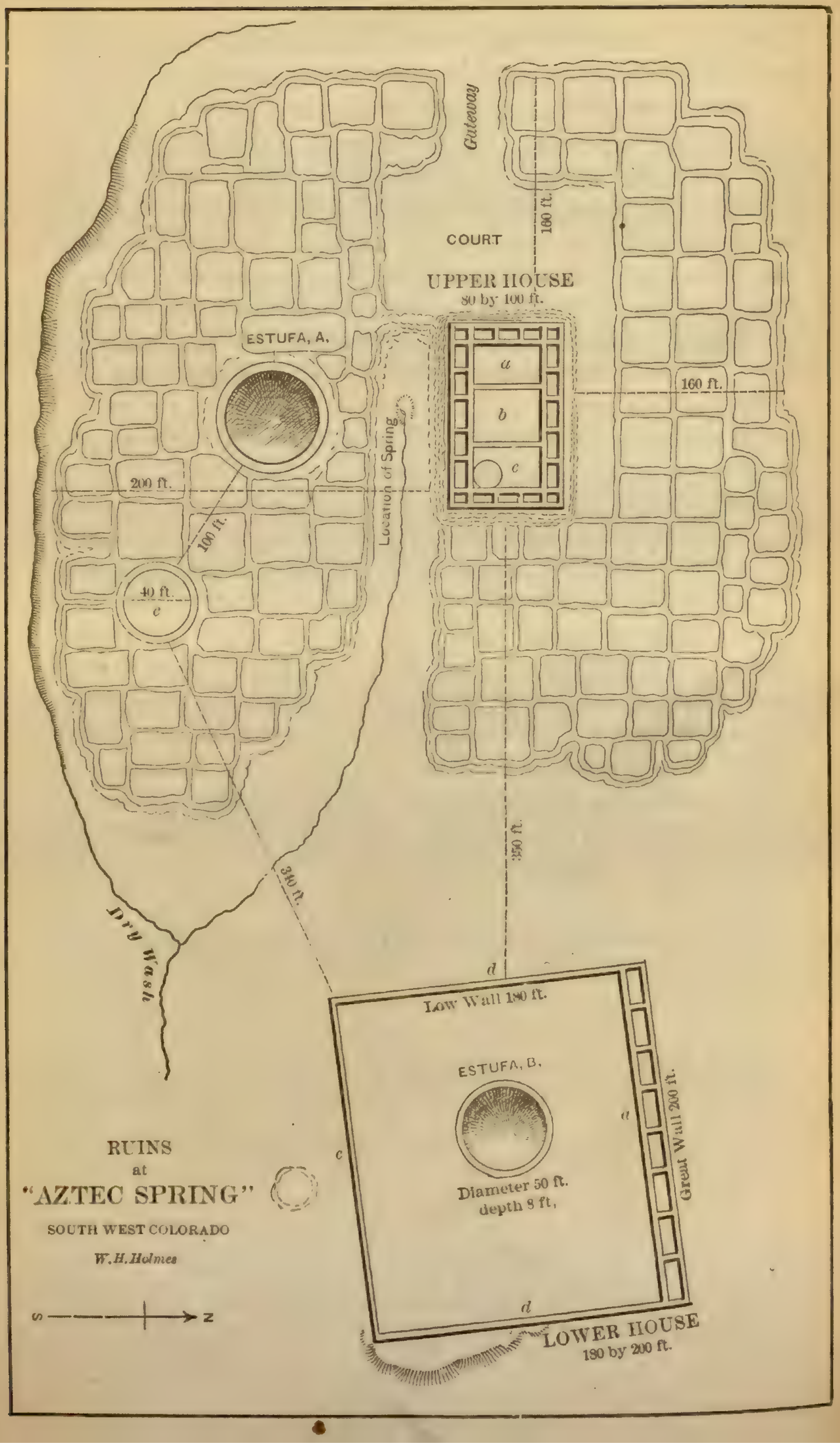
immediate vicinity of all of the larger remains. Great battles had been fought, and each stronghold was given up only after a prolonged and valiant resistance.

In the extreme south-western corner of Colorado stand the ruins of a once populous settlement, which we will call *Aztec Spring*. The *débris* of the destroyed city, covers an area some 600 by 800 feet in extent. The majority of the walls of the smaller houses near the out-skirts have crumbled away and now present nothing to the view but scarcely distinguishable mounds, or lines of original foundation. The houses had been built of different shapes, usually quadrilateral or circular, and were *generally* of small size, containing as a rule but one room. At the northern end of the *puéblo* or town, however, portions of the walls of two immense parallelogramic valley structures are still standing, whose surroundings seem to indicate that they had been erected with a view to the mutual protection of a large number of people, and for the purpose of resisting a protracted siege. They had been placed side by side, facing almost due north, with a space between them of several hundred feet. The northern circumvallations at present, reach a height varying from eight to eleven feet, while the remaining sides and the interior partitions lie in a jumbled mass of decay. This is owing to the fact that the latter were constructed of adobe. The northern faces, only, were built of stone. (See Plate III, for ground plan of the village. This and the other illustrations were kindly loaned by Prof. Hayden.)

Over all, a gnarled vegetation has sprung up, consisting of Cacti, Artemisia or sage-brush, and almost impenetrable thickets of grease-wood.

The stones had been cut symmetrically into rectangular blocks, and evenly dressed with stone implements; the pieces averaging a foot in length, four to six inches in thickness, and half a foot in breadth, being usually so laid that those of one layer, would break joints with those of the next above and below. The mortar with which the walls had been cemented, was simply an adobé clay, but as this contained some calcareous dust from the powdered limestones which occur in this locality, it has in time become as hard as the stones which it joins together. The edges of the blocks, as well as the surface of the plaster have been wearing away for centuries beneath the disintegrating action

PLATE III.


Gateway
160 ft.
COURT
UPPER HOUSE
80 by 100 ft.
ESTUFA, A.
a
b
c
160 ft.
200 ft.
100 ft.
40 ft.
c
Location of Spring
350 ft.
340 ft.
Dry Wash
d
Low Wall 180 ft.
ESTUFA, B.
Great Wall 200 ft.
a
c
Diameter 50 ft.
depth 8 ft.
d
LOWER HOUSE
180 by 200 ft.
RUINS
at
"AZTEC SPRING"
SOUTH WEST COLORADO
W. H. Holmes
S
N

of the elements, yet the remaining walls, which measure nearly three feet in thickness, are as firm as ever, and will in all probability thus continue for hundreds of years to come. In the distance, the great Mesa Verde (the green plateau) rises a thousand feet and stretches away for many miles to the north and east. It was from these cliffs that the blocks of stone in the neighboring ruins were cut and carried a distance of two or three miles.

A short distance below these remains and in the dry *arroyo* or cañon, locally known as the Rio McElmo (or, more properly, the Rio McElmell) is noticeable, in passing along the trail in the valley, the lower portion of a dark-brown circular tower, built far up among the rocks of the neighboring bluff, on a large bowlder, at the brink of a sheer precipice, (Fig. 1).

Fig. 1. Watch Tower on the Rio McElmo.

A very ancient path, now almost obliterated, leads up to the ruin. The structure, as well as the rock on which it stands, is

about ten or twelve feet in diameter, and the walls of the former may still reach a height of ten feet. This was undoubtedly used as a watch-tower by its builders, and the situation chosen for it was an admirable one for overlooking the gulch many miles both above and below. From this point, signals could be telegraphed to distant stations, in times of danger, while the miniature castle itself was so sheltered by the surrounding trees and *débris* as to escape the notice of careless observers.

The natural depression through which winds the parched bed of the Rio McElmo is particularly rich in all varieties of these architectural relics. In the vicinity of the ruins just described, and near the Utah border, is a peculiarly interesting cluster of fortifications. A mass of dark-red sandstone, a hundred feet in height, stands in the midst of an open plain, on the top of which the remnants of several walls are still visible. Around the base of the jagged butte are other indications of masonry, but the most perfectly preserved portion of the group is a rectangular apartment, built half-way up in the northern face of the bowlder, which has been named *Battle rock* or *Legendary butte*, because a legend exists amongst some of the tribes of that section relative to a great battle which had been fought there (Fig. 2).

In the immediate neighborhood of Battle rock may be seen a series of diminutive cave dwellings or store-houses. The natural caverns of the crumbling sandstones, formed by atmospheric erosion, were utilized by the Ancient Puéblos as they retreated southward. Little hollows scarcely exceeding six feet in diameter, were walled up at the mouths and occupied possibly as dormitories, or, more probably, as magazines or *cache*s, in which provisions were stored for safe keeping. Scores of these are found through all of the adjacent cañons, and in many instances they are situated hundreds of feet above the beds of the streams and were originally approached by niche-steps cut in the perpendicular cliffs, but which have been so worn away by time that they no longer present foot-holds for the adventurous climber.

If we advance in a westward direction some fifteen miles, to the dry valley of the Hovenweep (the name signifying, in the euphonious tongue of the Utah Indians, *deserted cañon*) we shall discover another large ruined structure, built on a miniature *mesa* or plateau in the center of the valley, rising to a height of fifty feet. On this the walls of a fortress or community dwelling are

heaped together, extending for a horizontal distance of two hun-

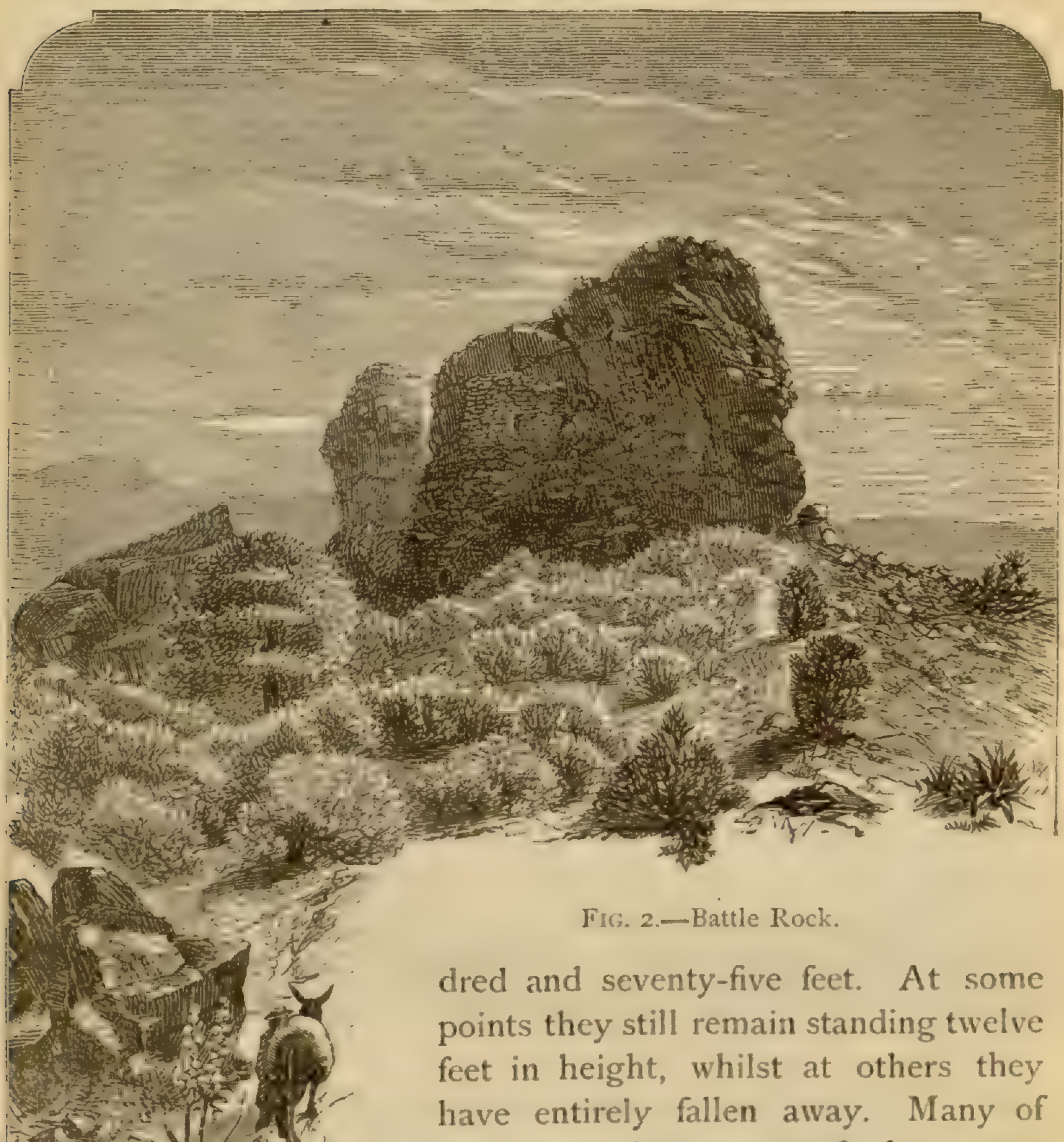


FIG. 2.—Battle Rock.

dred and seventy-five feet. At some points they still remain standing twelve feet in height, whilst at others they have entirely fallen away. Many of the external corners of the rooms were neatly and accurately curved, (see Fig. 14, Plate IV). In the plaster, the impressions of knuckles, finger-tips and nails are quite distinct, and in some instances, the very delicate lines of the epidermis are distinctly visible in the prints.

We cannot doubt that a multitude of workmen were employed in masonic labor, for in order to construct such huge edifices, a great amount of manual labor would be required, in the transportation of stone for many miles, trimming it into blocks, laying it in the walls, preparing the mortar, cutting cedar beams and rafters, plastering the external or internal walls with a coating of adobe, etc., and these operations may have required, in many cases, years for the completion of a single building. When we consider

the difficulties with which these pioneer architects had to contend, resulting from the imperfection of their stone implements, in the absence of any metal tools, we are filled with wonder and admiration in viewing the results of their patient labor.

A remarkable cliff-house was discovered in the cañon of the Mancos river, a northern tributary of the San Juan, in the summer of 1874. Mr. W. H. Jackson, the photographist of the expedition, thus describes it: "Just as the sun was sinking behind the western walls of the cañon, one of the party descried far up the cliff, what appeared to be a house, with apertures indicating two stories, but so far up that only the very sharpest eyes could define anything satisfactorily, as we had no field-glass with the party. The discovery of this, so far above anything heretofore seen, inspired us immediately with the ambition to scale the height and explore it. The house stood upon a narrow ledge, which formed the floor, and was overhung by the rocks of the cliff. The depth of this ledge was about ten feet, by twenty in length, and the vertical space between the ledge and overhanging rock some fifteen feet. It was perched up in its little crevice like a swallow's nest, and consisted of two stories, with a total height of about twelve feet. The only sign of weakness was in the bulging outward of the front wall, produced by the giving way or removal of the floor beams. Most peculiar was the dressing of the walls of the upper and lower front rooms; both were plastered with a thin layer of some firm cement of about an eighth of an inch in thickness, and colored a deep maroon-red, with a dingy white band eight inches in breadth, running around floor, sides and ceiling. In some places it had peeled away, exposing a smoothly dressed surface of rock." (Plate IV, Fig. 12).

Such are the outlines of a pen picture of an isolated ruin which has attracted, since its discovery, much attention, both at home and abroad. A number of clay models have been recently made of it, which have been placed in several of the most famous museums in Europe. It already figures in some of the standard works on the aboriginal inhabitants of North America,[1] and is considered one of the most unique specimens of ancient architecture thus far discovered in this section. The illustration will give a general idea of the house itself, but in order to realize its position in the cañon, a vertical distance of 800 feet must be

[1] *Vide* Bancroft's Native Races of the Pacific States, Vol. IV, p. 721.

PLATE IV.

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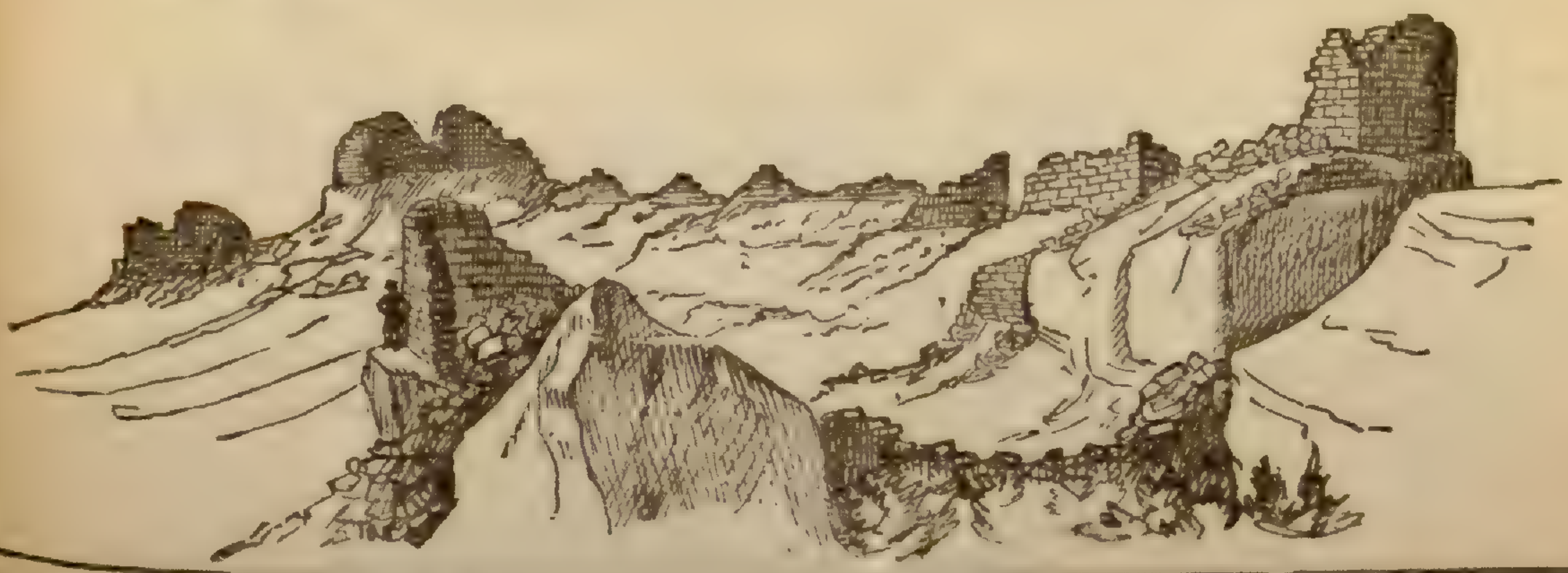

imagined, separating it from the level of the Mancos river flowing at the foot of the precipice.

The remains of an old tower are to be seen in the valley below, the walls of which are several feet in height, having the plaster crumbled almost entirely away from the interstices between the stones. The mounds of decay which lie within and without, show conclusively that the building at one time was many times as high as it now appears. In the vicinity quantities of highly glazed and ornamented pottery lies scattered around, but all of it in a fragmentary condition.

Through the neighboring cañons occur thousands of these interesting mural remains, but space forbids the mention of more than a few of the most characteristic.

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THE NEW CARPET BEETLE—ANTHRENUS SCROPHULARIÆ.[1]

BY J. A. LINTNER.

DURING the summer of 1874, notices appeared in various newspapers of the ravages of a carpet-beetle, quite different in its appearance and in the character of its depredations from the well-known carpet-moth, *Tinea tapetzella*, which for so long a time had been the only known insect depredator on our carpets.

Its *habitat* was stated to be beneath the borders of carpets where nailed to the floor, eating in those portions numerous holes of an inch or more in diameter. Occasionally it made its way into the crevices left by the joinings of the floor, following which, entire breadths of carpet would be cut across as by scissors. In several instances carpets had been destroyed — new ones as readily as older—and it was questioned whether their use could be continued, in view of a prospective increase of the alarming ravages.

The insect was new to every one, and no one could form a rational conjecture as to what order of the Insecta it belonged. It was described as a small ovate object, about one eighth of an inch in length, thickly clothed with numerous short bristle-like hairs, and terminating in a pencil of these, forming a tail. It was exceedingly active in its motions, and when disturbed in its con-

[1] From advance sheets of the Thirteenth Annual Report on the New York State Museum of Natural History.

cealment would glide away beneath the base-boards or some other convenient crevice so quickly as in most instances to elude capture for its closer inspection. They were found only during the summer months.

In 1876 it was reported in many dwellings in Schenectady, and in the month of July examples of it, for the first time, came under my observation, taken, upon search having been instituted, under the carpets of my residence at Schenectady, where its presence had not been suspected. It was evident, on the first inspection, that it was the larva of a beetle, and in all probability a member of the very destructive family of *Dermestidæ*, which comprises several of our most injurious depredators on animal substances.

A number of the larvæ were secured and fed upon pieces of carpet in order to rear them. In September they had evidently matured, and had assumed their quiescent pupal state within the skin of the larva, first rent by a split along the back for the escape of the perfect insect. At this stage they presented characters which led me to refer them, in all probability, to the genus *Anthrenus*.

In October, the first perfect insect emerged. Being entirely new to me, they were sent to Dr. LeConte, the distinguished coleopterist of Philadelphia, for determination. He returned answer that they were the *Anthrenus scrophulariæ* Linn.—a species well known in Europe for its destructiveness, but now for the first time detected in this country.

Notice of the discovery was communicated by me to the Albany Institute at its meeting of October 17, 1876, and a report of the same published in the *Albany Argus* of October 21st. Owing to the interest attached to the introduction in our country of another addition to the already formidable list of injurious insects of European origin, the paper, or extracts therefrom, appeared in several of the journals of this and adjoining States. Through the publicity given it, I became informed of the presence of the insect in many localities in New York and other States. Examples of a beetle, believed to conform to the brief description which I had given of *A. scrophulariæ*, and known to possess the like habit of feeding upon carpets, were sent to me by Mr. A. S. Fuller of the *Rural New-Yorker*, for comparison. The species had been in his cabinet for some time, under the name of *Anthrenus lepidus* LeConte, having received the first

examples from Oregon in 1871 or 1872. Later, in 1874, specimens referred by him to the same species were found abundantly in a dwelling in Market street, New York, and thereafter in various parts of the city and neighboring localities. The examples reared by Mr. Fuller from larvæ taken in New York city were clearly identical with *A. scrophulariæ.* Upon informing Dr. LeConte that examples of this species were in cabinets under the name of *A. lepidus* and requesting an explanation, he wrote me that the latter name had been given by him to a form which he had found on flowers at San Francisco and San Jose in 1850;[1] that it differed from the *A. scrophulariæ* of Europe in its sutural line being white instead of red; but that in all probability it should only be regarded as a variety of the European species.

Dr. LeConte suggests that it may have been imported into California from Southern Europe during the Spanish occupation of that country. The eastern invasion of the insect, he believes to have been within a few years through the importation of carpets at New York.

The accompanying figures, very faithfully drawn by Prof. Riley, represent *A. scrophulariæ* in three of its stages, viz: *a* the larva, *c* the pupa, and *d* the imago or beetle. At *b* the skin of the larva, after the beetle has emerged from the fissure on the back, is shown. The figures are enlarged, the lines beside them representing the natural size.

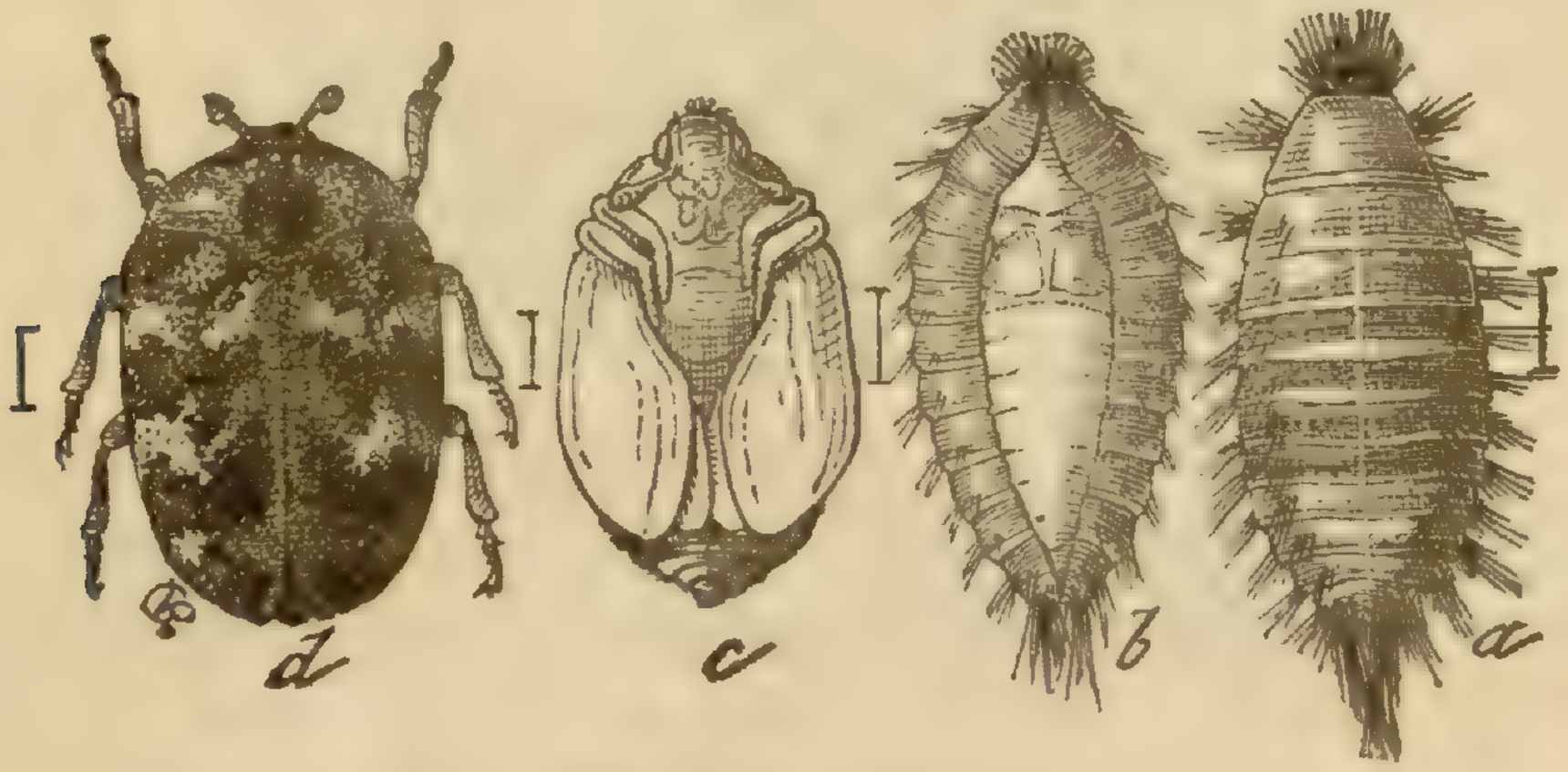

FIG. 1.—The New Carpet Beetle.

The larva—the form in which it is usually found when pursuing its ravages beneath the carpets—measures, at maturity, about

[1] *A. lepidus*, breviter ovatus, supra niger, thoracis lateribus albo-squamosis, gutta nigra inclusa, elytris fasciis tribus angustis suturaque albo-squamosis, macula antica suturali aureo-squamosa ornatis, basi parce albo-squamosis. Long. .11 in San Diego, Cal.—*Proc. Acad. Nat. Sci., Phila.*, 1854, p. 112.

three-sixteenths of an inch in length. A number of hairs radiate from its last segment in nearly a semicircle, but are more thickly clustered in line with the body, forming a tail-like projection almost as long as the body; this terminal pencil of hairs is not shown in its full extent in the figure, doubtless taken from an immature individual. The entire length of the insect, including the pencil of hairs, is, in the largest specimens, nearly three-eighths of an inch. Measured across the body and the lateral hairs, its breadth just equals the length of the body. An ordinary magnifier will show the front part of the body, where no distinct head is to be seen, thickly set with short brown hairs, and a few longer ones. Similar short hairs clothe the body—somewhat longer on the sides, where they tend to form small tufts. Towards the hinder end may be seen on each side three longer tufts (thrice as long) projecting laterally; but these are not always visible, as the insect by the aid of a peculiar muscular arrangement, has the power of folding them out of sight along its sides. The body has the appearance of being banded in two shades of brown—the darker band being the central portion of each ring, and the lighter, the connecting portion of the rings, known as the incisure. By turning it upon its back, the six little legs, of which it makes such good use, can be seen, in vigorous efforts to regain its former position—its struggles while in this condition sometimes producing a series of jumps of about an eighth of an inch in length.

Having attained its full growth, it prepares for its pupal change without the construction of a cocoon or any other provision than merely seeking some convenient retreat. Here it remains in a quiet state, unaltered in external appearance, except somewhat contracted in length, until it has nearly completed its pupation, when the skin is rent along its back, and, through the fissure, the pupa is seen. A few weeks having passed, the pupal skin in its turn is split dorsally, and the brightly colored wing-covers of the beetle are disclosed. Still a few additional days of repose are required for its full development, when the now fully matured beetle crawls from its protective coverings of pupal case and larval skin, and appears in its perfect form—its final stage.

The earliest beetles emerge in the month of October, and continue to make their appearance during the fall, winter and spring months. Soon after their appearance probably, they pair, and the

females deposit their eggs for another brood of the carpet-eating larvæ.

The beetle is quite small, smaller than would ordinarily be expected from the size of the larva, being only about one-eighth of an inch long by one-twelfth broad. An average of five examples before me gives, length .125 inch, breadth .085 inch. Its form is almost a perfect ellipse as seen from above; its back and under surface are quite rounded. When turned upon its back, it often for a few moments counterfeits death, with its legs so closely folded to the surface as scarcely to be seen, and in this state the ordinary observer might be at a loss to know the lower from the upper side.

It is a beautifully marked little insect in its contrasting colors of white, black and scarlet, arranged as follows: The edge of each wing-cover, where they meet on the back, is bordered with red (forming a central red line), with three red projections from it outwardly, one on the middle of the back, and one other toward each end. Take a straight line and divide in four equal parts by three cross lines, and we have nearly the position of these projections. At the extreme tip of the wing-covers is a widening of the bordering line, making almost a fourth projection from it. The first projection, near the head, is connected with a white spot, running upwardly on the middle of the front border of the wing-cover. On the outer border of the wing-covers are three white spots nearly opposite the red projections. The intermediate spaces are black. The segments of the body beneath are covered with pale red scales, and the thoracic region (which bears the legs) with whitish scales. The above description, although not presented as a scientific one, will suffice for the identification of the beetle when met with. The detection of this insect adds to our fauna another species of the dreaded genus *Anthrenus*, which there is reason to fear will equal in its destructive agency the well-known museum pest, the *A. varius* (formerly known as *A. musæorum*), the obtrusive guest of all our collections of natural history, whose ravages it seems impossible fully to guard against, and so exceedingly difficult to control.

It does not confine itself wholly to carpets, but it also infests and injures various articles of wearing apparel, hanging in closets or lain away in drawers. An instance has also been stated, but awaits confirmation, of its preying upon cotton fabrics—a habit not attaching to either the clothes or carpet moths.

It is known to have become almost ubiquitous in a house which had been for some time occupied by it, notwithstanding the persistent efforts made for its extirpation. Its exuviæ were encountered in trunks, boxes, tied-up packages, drawers, beneath floor oil-cloths, etc. Late in the season (October) clusters of twelve or more of the full-grown living larvæ were disclosed, to the disgust and dismay of the housekeeper, in turning over a paillasse, the borders of which they had selected as a safe retreat on which to undergo their final transformation.

I have this present year found that a convenient place in which to discover the beetle, is upon the windows of the infested rooms during the day. In the latter part of April examples were taken upon the windows of my residence in Schenectady. After the middle of May, a systematic search instituted for them, gave several examples each day. In the six days from May 17th to 22d, forty-four specimens were taken from the three windows of two upper rooms. Should investigation show that the beetle is drawn to the windows before the deposition of its eggs, their ready capture and destruction at this time will offer an easy method of preventing their increase.

Should this insect continue to increase until its complete naturalization shall make it as common as *A. varius* (a dozen or more of which may sometimes be seen feeding on a single flower), it is difficult to conceive how, under such a visitation, the comfort of carpets can still be indulged in within our homes. Even now, when it has barely commenced its ravages, it is reported as having inflicted very serious pecuniary losses in several instances, where carpets have been entirely ruined; and such terror has its presence imparted, that not a few prudent housekeepers have already abandoned the customary nailing of their carpets to the floor, that frequent examinations may be made during the summer months for the discovery and destruction of the unwelcome guest.

The remarkable invasion of a dwelling in Cold Spring, N. Y., in the summer of 1874, after a twelve months' absence of the family in Europe, was by a larva of *Anthrenus* (as determined by Dr. Packard), which is now believed to have been this species. According to the statement made, "they took complete possession, from the cellar to the attic, in every nook and crevice of the floors, under matting and carpets, behind pictures, and eating

everything in their way." From this account we may infer an almost incalculable capability of increase if left to itself, and draw the lesson of the absolute necessity of combatting its invasion by every means in our power.

It will unquestionably prove an exceedingly difficult pest to dislodge. The ordinary applications of camphor, pepper, tobacco, turpentine, carbolic acid, etc., are powerless against it. It has even been asserted that it "grows fat" on these substances. An effectual means of destruction, and preventive against new invasions, is still to be discovered. The free use of benzine has been recommended in some of our journals, to be used in the saturation of cotton, with which to fill the joinings of the floors and crevices beneath the base-boards. This is to be done during the winter months, at which time the insect will be occupying these retreats, either in its perfect beetle form, or as eggs deposited for another brood; to either of these the direct application of benzine would be fatal. To some of my correspondents I have suggested the pouring of kerosene oil in the crevices of the floors, and filling of all places of retreat with cotton saturated with the oil. I would regard this as less dangerous in its use than benzine, and equally efficient.

The recommendation recently made in several of our newspapers, of the Persian insect-powder for the destruction of the insect, I believe to be of no value. I have not deemed it worth the trouble of experimenting with, but I have been told by those who have given it a trial that it has been found to be of no avail whatever.

The insect has not as yet become sufficiently abundant in New York to be found resorting to plants for its food. The variety *Anthrenus lepidus*, which was introduced in California sufficiently long ago to permit its complete naturalization, was discovered there, in numbers, feeding upon some of the Compositæ. The *Anthrenus varius* is often found, in its perfect state, taking its food from the blossoms of different plants in the garden or field. I have met with it abundantly on peonies. It has also been found to frequent the rocket flower, *Hesperis matronalis*, a fragrant and showy perennial. If the plants known to be attractive to the *A. varius* can be introduced into our houses, and made to flower during the months of April and May, I believe that the carpet-beetles would be drawn to them in preference to windows, perhaps as soon as they emerge from the pupæ.

We are unable to give at the present any precise statement of its distribution. It is known in Oregon, as well as in California. It is believed to be distributed throughout most of the western States, and it is known to occur in various portions of the State of New York. It is announced as having appeared in considerable force in Syracuse. In Utica it has inflicted serious damage in many dwellings. From Brockport the information is received that "it has been very destructive for the last three years. In spite of all the means which can be used, it is increasing in number, and threatens to destroy the carpets and all other woolen goods." It has occurred at Buffalo, but not so abundantly as to have originated the name sometimes applied to it—the *Buffalo bug*—a name given to it on the Pacific coast probably, from a fancied resemblance to that animal. Its presence has also been detected in Albany, but no serious ravages have been reported. It has occasioned much alarm in several places in the State of New Jersey. Without doubt it is committing its depredations in many localities where its work is ascribed to the carpet-moth, than which it is a far more pernicious insect.

A lady to whom I was relating the destructive capabilities of the new pest, congratulated herself that her carpets were free from it. The following morning her husband brought to me a beetle which he had taken from his face during the night, which proved to be the creature that I had described to her the previous evening—the abundant presence of which in her home, she had not suspected.

From the serious nature of its depredations as above referred to but in part, the secrecy with which it conducts them, the extreme difficulty with any known appliance of eradicating it—it becomes very important, as a preventive against its alarming increase, that it should, from the outset, be combatted by all the means known to be efficacious against its allied forms, or which may give promise of success as against a new foe.

It may be interesting, in connection with the above notice of this last importation, to recall the fact that nearly all of our most injurious insects have been introduced from Europe. Of a long catalogue given by Professor Riley, in one of his valuable reports, a few may be mentioned here:

The Hessian-fly (*Cecidomyia destructor*), the wheat-midge (*Diplosis tritici*), the cheese-maggot (*Piophila casei*), the house-fly

(*Musca domestica*), the currant-worm (*Nematus ventricosus*), oyster-shell bark-louse (*Aspidiotus conchiformis*), several species of plant-lice (*Aphides*), the cockroach (*Blatta orientalis*), the croton-bug (*Ectobia germanica*), the meal-worm (*Tenebrio molitor*), the grain-weevil (*Sitophilus granarius*), the bee-moth (*Galleria cereana*), the codling-moth of the apple (*Carpocapsa pomonella*), the cabbage-moth (*Plutella cruciferarum*), the carpet-moth (*Tinea tapetzella*),[1] the clothes-moth (*Tinea vestianella*), the fur-moth (*Tinea pelionella*),[1] the currant borer (*Ægeria tipuliformis*), and within the few past years, the asparagus-beetle (*Crioceris asparagi*), and the well-known destructive cabbage-butterfly (*Pieris rapæ*). All of these, and the formidable list might be greatly extended, we have received from Europe, while very few of our native insect pests have been sent in return. Should our late exportation of the Colorado potato-beetle (*Doryophora decemlineata*), prove as injurious in Europe as in this country, which there is much reason to doubt, we shall still be very far from having made a commensurate return. While the few American species which have been introduced in Great Britain and on the continent have not spread to any great extent, in almost every instance where injurious insects have been brought thence to this country, their number and their ravages have been greatly increased. Thus, while the recent advent of the *Anthrenus scrophulariæ* has brought consternation in many of our homes, we have been unable to find any record of its preying upon carpets, or other woolens, in the Old World, where it has been so long known. Even special inquiry made by me of one of the leading Entomologists of Europe, has failed to elicit any such information. It is said there to infest dried meats and similar substances. Perhaps its fondness for carpets is a new taste which its transportation hither has developed.

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RECENT LITERATURE.

Emerton's Structure and Habits of Spiders.[2]—This is eminently a book for boys and girls who are in any way interested in natural history, as it is a simple, readable, thoroughly intelligible account of the external and internal structure of spiders, with their classification; while, as an account of the more

[1] Mr. V. T. Chambers finds differences in these two species from the European ones (*Canadian Entomologist*, 7, pp. 124, 125).

[2] American Natural History Series, vol. 2. *The Structure and Habits of Spiders.* By J. H. Emerton. Illustrated. Salem, S. E. Cassino, Naturalists' Agency, 1878. 12mo, pp. 118.

striking habits, indoors and out, of these interesting creatures, it is the best and most original book in our language. Lending a great charm and interest are the original photo-electrotypes, many illustrating the spiders in the process of spinning their webs, laying their eggs, and showing the various forms of nests and cocoons for housing the eggs. The naturalness of the drawings, especially those of the spiders standing on tip-toe (viz: Figs 40, 41, 42); of the spiders laying eggs (Figs. 56, 57, 58, 59, 60), have certainly never been surpassed. In all these matters our author's many years' observations of spiders and their ways, and his facile pencil, as seen not only in the drawings of the entire spiders, but also the anatomical details, give this little book the air not only of the work of an adept in the difficult art of observation, which makes the book thoroughly popular and interesting to the young, but it is really, in its way, an admirable, authoritative monograph.

The figure (8) on page 20, illustrating in a general manner the internal anatomy of a spider, is a most successful drawing, and not surpassed for clearness and intelligibility. We congratulate the author on the success of his first literary venture, and the publisher on the beautiful and tasteful dress of the book, and trust that the remainder of the series will add to the number, now so small, of American books for American boys and girls, which shall not only instruct but attract them strongly to the study of nature in the fields and woods, or at least out of doors.

Our main cause for fault-finding with Mr. Emerton's book is that there is not more of it. At times he is too brief; fifty pages more would have added to its value, and in some places he might have entered into longer explanations without wearying his readers. On page 12 we should have preferred the word cephalo-thorax, or head-thorax, instead of thorax. There is little in the book which is not original, most of it will be quite new to naturalists, and we anticipate that it will give a fresh stimulus to the study of spiders, which have such highly-developed reasoning powers, and which, the more we know them, become the more interesting, despite their repulsive exterior and often disagreeable manners.

THE NATURALISTS' DIRECTORY FOR 1878.[1]—The title given below so well characterizes this useful publication that we need but call attention to a new feature in the work, viz., the addition of a list of scientific societies, clubs, museums, etc., in the United States and Canada, with the addresses of the Presidents and Secretaries. Though on casual examination we notice one or two errors, the work of compilation, difficult enough to perform

[1] *The Naturalists' Directory for 1878*, containing the names of the Naturalists of America north of Mexico, arranged alphabetically, and by departments; also a list of scientific societies, and a catalogue of obtainable scientific books, arranged by subjects. Edited by SAMUEL E. CASSINO. Salem, Naturalists' Agency, 1878. 12mo, pp.

without omissions, has been apparently well done, and it remains for those whose names are mentioned in it to keep the Editor informed as to the changes in residence, &c.; in this way a work in which all are interested may be well maintained.

HAYDEN'S GEOLOGICAL AND GEOGRAPHICAL ATLAS OF COLORADO.[1]—The publication of this noble work is appropriate at the present time, as indicating that our government, although subject to the vicissitudes so incident to its popular form, does not forget the highest interests of the people. The great survey under Dr. Hayden, of which the present atlas is the latest product, appeals in it to the public interest in the most direct manner. Nothing can be more desirable for a community to know than the material constitution of their possessions, and in no way is this knowledge more quickly and exactly communicated than by the geological map.

This atlas consists of sixteen folio maps, in two series. The first of these consists of four maps on a scale of twelve miles to the inch; the second of twelve sheets on a scale of four miles to the inch. Of the second series, six maps are topographical and six geological. The maps of the first series include a drainage map and a map indicating the distribution of vegetation. The importance of the latter to the emigrant is alone worth the cost of the atlas. The topography is expressed by contour lines representing intervals of two hundred feet, which is the best mode of expression of surface configuration. The various types of country are thus perceived at a glance; the craggy peaks, the plains and the cañons being as well marked as in a birds-eye view.

In the geological department Dr. Hayden's work is prominently displayed. The vast series of Mesozoic and Tertiary strata which form the central district of our continent were first distinguished, located and stratigraphically defined by the author, who has now the satisfaction of seeing his prolonged labors set forth in a form commensurate with their importance, so far as regards the great State of Colorado. No more extensive area, horizontally or stratigraphically, ever fell to the lot of a single geologist to translate into the language of science, than has been, for the past twenty-five years, the heritage of Dr. Hayden. The grandeur of the result may be estimated by remembering that the present atlas covers a very small fraction of the area explored and digested. An examination of the present series of maps will furnish some idea of the labor and energy expended in the work. We have here the results of the studies of Dr. Hayden's able corps of assistants as well as of his own. Of these gentlemen it would be invidious to select any for special mention. The suc-

[1] *Geological and Geographical Atlas of Colorado, and portions of adjacent territory.* By F. V. HAYDEN, U. S. Geologist-in-charge. Department of the Interior, United States Geological and Geographical Surveys of the Territories, 1877.

cess of the atlas as a work of art reflects equal credit on the artist and engraver. An especial feature of the work, as of many of Dr. Hayden's reports, is the analytical landscapes of Mr. Holmes. These representations, which conclude the atlas, enable the reader to realize, by a vertical projection, the teachings of the preceding maps and charts.

Every citizen of our country will feel increased respect for his government, which fosters works like the present; and the complaint that a republican form is discouraging to the development of science within its limits is shown every day to be without foundation.

THE PENN MONTHLY for June, 1878.—This magazine deserves well of the thinking community as an enterprise for the dissemination of fact and argument in all questions of the highest moment. The present number contains an article which interests us especially, entitled, "The relation of the Mosaic Cosmogony to Science," by C. B. Warring, Ph.D. It is another attempt to reconcile the account of creation, given by Moses in the first chapter of Genesis, with the facts which have been ascertained by investigation, and which form the branches of science known as geology and palæontology.

Mr. Warring approaches the subject in a judicial spirit, and with an evident desire to ascertain the truth of the matter. He is careful to disavow responsibility for the statement of many friends of the Mosaic record, which cannot be substantiated by the text. He also admits the validity of the conclusions attained by scientific men in physics and geology. These conclusions he arranges under twenty heads, commencing with the former department and ending with the latter. These are fairly stated, but we leave to our friends the physicists the assertion that light is the primal form of motion and force, and the new theory propounded by the author which accounts for the glacial epoch and the climatic zones, by supposing a pre-glacial change in the direction of the earth's axis of 22°. A closing statement of this part of the subject, which is derived from Dana, is open to such doubt as to be invalid as evidence: it is, that "every fish, bird, reptile and mammal of the Tertiary is now extinct."

The general coincidence of the Mosaic account with these facts is then displayed, in so far as they relate to the earlier and middle portions of geologic history. That such a similarity between the two records exists, is a well-known fact, and one which assures to Moses' cosmogony the first place among those which have come down to us from ancient times. Whether, however, the coincidence is sufficiently exact to warrant the high estimate placed upon it by many theologians, and the assertions made as to its supernatural origin, is a very different matter. In discussing this part of the subject, our author is not free from

bias, which we think he displays in a disposition to see more scientific precision in the language of Moses than a plain reading of the text will permit.

First, as to the statement that the Mosaic account "does not speak of any vegetation, except seed-yielding herbage and trees whose fruit enclosed the seed." We think that the text will not bear this restricted interpretation. It says, "Let the earth bring forth grass, the herb yielding seed and the fruit tree yielding fruit after his kind, whose seed is in itself, upon the earth." It is, to our mind, a gratuitous assumption, that the language "whose seed is in itself," signifies vegetation "whose fruit encloses the seed," or angiospermous plants. But even supposing this to be the rendering of the text, the seeds of gymnospermous plants are enclosed in the unripe cones for a considerable time, and to ordinary observation the opening of the cones at maturity does not differ from the same process in a seed vessel. By claiming too much morphological meaning for the text, Mr. Warring taxes our credulity too seriously. What he further understands by the language "herb yielding seed," will appear later; for us, it means any kind of vegetable whatever.

Second, we note the relation of this Mosaic statement to the facts of vegetable palæontology. The author of the article, finding that the angiospermous plants have not yet been found below the Cretaceous horizon, concludes that Moses referred to this period when describing the creations of the "third day." He evidently thinks that Moses intended phænogamous plants in the expression, "herbs yielding seed," that is, that he distinguished seeds from the spores of cryptogamic plants. Here again he goes beyond the legitimate use of the text. For us, Moses describes the creation of all kinds of vegetation, cryptogamic as well as phænogamic, and that any relation of the text to the history of the Cretaceous period is imaginary. Indeed, the ancient record is better supported by the liberal interpretation which we give it. But this coincidence of the enlarged interpretation with geologic history is not so remarkable as to be incapable of explanation on rational principles. In the Mosaic text the creation of plants very naturally follow the first elevation of land, as it could not have taken place earlier; and it precedes its occupation by animals, in plain accordance with the necessary existing relations of the two forms of life, as open to the view of any observing person.

Thirdly, a greater significance than the language admits of, is discovered by the author under consideration, in the verse with which the account of the third day's work opens. It reads, "Let the waters under the heaven be gathered together unto one place," "a remarkable statement," says our author, "to come from one who knew only of separate bodies of water and nothing of their real connection. We now know that the oceans are all one." For us, the latter is the more remarkable statement of the two,

implying an obscurity in the mind of its author as to the meaning of the words "one place," etc.

Fourthly; but supposing Moses to have referred to the Cretaceous period in his account of the third day, our essayist labors under the difficulty of having admitted that the creation not only of plants but of all the greater and many of the minor divisions of the animal kingdom took place before that of the sun and moon on the fourth day. And if we allow the utmost freedom to the commentator and understand the text to mean before the *appearance* of the sun and moon to the inhabitants of the earth, we have an equally impossible proposition.

The author leaves for another article his explanation of the relation of the "days" to the geologic record. Here he will have a more difficult task before him than that which he has already attempted. The order of succession indicated by Moses is, in general, correct, but the division into epochs is not only not in accordance with the facts now in our possession, but is not consistent with itself. Thus the introduction of "fowl" on the first day of the animal creation is far from justifiable, as is also the creation of "whales" at the same time. These forms were comparatively late creations, and if the language "every living creature that moveth, that the waters brought forth," means the first animals, as its place in the same text indicates, then we have another serious anachronism. If, on the other hand, this sentence is to be disregarded, then there is no narration of the origin of animals. Then again, the time of origin of "everything that creepeth upon the earth after his kind," whether reference is made to insect or reptiles, comes on the sixth day, and after the creation of birds and whales, instead of anterior to them, as the science of palæontology clearly shows to have been the case. In fact there is no general difference between the proceedings of the fifth and sixth days beyond that indicated by the habitat of animals, *i. e.*, whether they be aquatic or terrestrial; and this distinction is only valid as relates to one class, the fishes, but has no significance otherwise, and least of all any agreement with the geologic record.

HAECKEL'S PROTISTA-KINGDOM.[1]—This is a strong reaffirmation, in popular language, of Haeckel's belief in a kingdom of organisms, comprising certain protophytes and the Protozoa, which forms neutral ground between the animal and vegetable kingdoms. It seems to us to be an unnatural and unnecessary combination, though from some points of view useful at this time. The illustrations are excellent. The right of Bathybius to be regarded as an organism is stoutly maintained. The pamphlet deserves translation into English, for whatever Haeckel writes is worth reading, whether all his conclusions are accepted or not. He is a force in the scientific world; certainly not a protist.

[1] *Das Protistenreich, Eine populäre Uebersicht über das Formengebiet der niedersten Lebewesen. Mit einem wissenschaftlichen Anhang; System der Protisten.* Von E. HAECKEL. Mit zahlreichen holzschnitten. Leipzig, 1878. 8vo, pp. 104.

ANNUAL RECORD OF SCIENCE AND INDUSTRY FOR 1877.[1]—While this year's volume is less bulky than its predecessors, it has lost none of its distinctive features as a useful summary of the progress of science in all departments, with especial reference to the wants of the specialist who must be informed as to progress in general science, as well as of the general reader who needs some handy, condensed year-book of this sort, to supplement the encyclopædia and other books of reference in his library. The work seems to be admirably classified and condensed and in all respects as useful and rather more compact, and cheaper than the previous ones.

COOK'S MANUAL OF THE APIARY.[2]—This manual of bee-keeping is in point of style not equal to Langstroth's or Quimby's, but still is excellent in its matter and will prove a reliable and practical guide to the beginner. The illustrations are in most cases good, in others mediocre, but still they are numerous, and unusual prominence is given to physiological and anatomical facts and theories. The index is copious and convenient.

THORELL'S STUDIES ON THE SPIDERS OF MALAYSIA.[3]—The first part of this series of descriptions of the Arachnid fauna of Malaysia, and of the Celebes especially, forms a volume of 294 pages, with an index, and must comprise when completed a quite full description of the spiders of Malaysia and Pupuana. The descriptions are detailed and in Latin.

RECENT BOOKS AND PAMPHLETS.—Brehm's Thierleben. Band x. Heft 7–10. Leipzig, 1878. New York: B. Westermann & Co. 8vo, 40 cents a Heft.

Die europäischen Encyrtiden. Von Gustav Mayer. Wien, 1878. 8vo, pp. 104.

Beiträge zur Schmetterlings-Fauna von Surinam. II. Von N. B. Möschler. Wien, 1878. 8vo, pp. 72, 3 plates. From the author.

Entomological Contributions, No. iv. By J. A. Lintner. From the Thirtieth Annual Report on the New York State Museum of Nat. History, for the year 1876. Printed in advance of the Report. Albany, June, 1878. 8vo, pp. 142.

Studi sui Ragui Malesi E. Papuani per T. Thorell. I. Genova Tipografia del R. Instituto Sordo-muti, 1877. 8vo, pp. 297. From the author.

American Club List and Sportsman's Glossary. By Charles Hallock. New York: Forest and Stream Publishing Company. 1878. 8vo, pp. 90.

Two interesting American Diptera, Glutops singularis and Epibates Osten-Sackenii. By Edward Burgess. From the Proceedings of the Boston Society of Natural History. Vol. xix. February 27. 1878. 8vo, pp. 2, with a plate. From the author.

Report on the Insecta (including Arachnida) collected by Captain Feilden and Mr. Hart between the parallels of 78° and 83° north latitude, during the Recent Arctic

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[1] *Annual Record of Science and Industry for 1877*. Edited by SPENCER F. BAIRD, with the assistance of Eminent Men of Science. New York, Harper & Brothers, 1878. 12mo, pp. 480.

[2] *Manual of the Apiary*. By A. J. COOK, Professor of Entomology in the Michigan State Agricultural College. Second edition, revised, enlarged, mostly rewritten and beautifully illustrated. Chicago: Thos. G. Newman & Son, 1878. 12mo, pp. 286.

[3] *Studi sui Ragni Malesi e Papuani*. Per T. THORELL. I. Genoa, 1877. 8vo, pp. 294, and index.

Expedition. By Robert McLachlan, F.R.S., F.L.S. (Extracted from the Linnæan Society's Journal—Zoölogy. Vol. xiv.) 8vo, pp. 25. From the author.

Das Protistenreich. Eine populäre Uebersicht über das Formengebiet der niedersten Lebewesen. Mit einem wissenschaftlichen Anhange: System der Protisten. Von E. Haèckel. Leipzig: Ernst Günther's Verlag, 1878. 8vo, pp. 104. Mit zahlreichen Holzschnitten.

Die europäischen Cynipidengallen mit Ausschluss der auf Eichen vorkommenden Arten. Von Dr. Gustav Mayer. (Aus dem 15, Jahresberichte der Rossauer Communal–Oberrealschule in Wien.) Wien: Alfred Nölder, k. k. Hof-und Universitäts-Buchhändler, 1876. 8vo, pp. 22, 3 plates.

The Ganoid Fishes of the British Carboniferous Formations. By Ramsay H. Traquair, M.D., etc. Part i. Palæoniscidæ 4to, pp. 1–60, plates i–vii. (Palæontographical Society, London.) Volume for 1877. From the author.

Beiträge zur Fossilen Flora Spitzbergens, gegründet auf die Sammlungen der Schwedischen Expedition vom Jahre 1872 auf 1873. Von Oswald Heer. 4to, pp. 141, plates 32. Stockholm, 1876. From the author.

Palæontographica, Beiträge zur Naturgeschichte der Vorzeit. 25te Band oder 3te folge. Erster Band 4te Lieferung. 4to, pp. 141–174, plates xix–xxii. Cassel, 1878.

On the Structure and Development of the Skull in the Urodelous Amphibia. Part i. By Wm. Kitchen Parker, F. R. S. 4to, pp.529–597, plates 21–29 (From the Philosoph. Transactions Roy. Soc. Vol. 167, part 2.) London, 1877. From the author.

Zur Stammes-geschichte der Spongien. Von Prof. Karl A. Zittel. 4to, pp. 20. (Read on the Fiftieth Anniversary of C. Th. von Siebold's Acadèmic Doctorate.) Munich, 1878.

Studien über Fossile Spongien. Zweite Abtheilung: Lithistidæ. By Prof. Karl A. Zittel. 4to, pp. 1–90, Taf i–x. (From the Abhand. der K. bayer. Akad. d. Win. ii. Cl. xiii. Bd.) München, 1878. From the author.

Description of the Fossil Reptilia of South Africa in the Collection of the British Museum. By Richard Owen, C.B., F.R.S. 4to, Vol. i, text pp. 88, accompanied by a 4to atlas, Vol. ii, of seventy plates. From the author.

The Ancient Life-History of the Earth: a comprehensive outline of the principles and leading facts of Palæontological Science. By H. Alleyne Nicholson, M.D., etc. 12mo, pp. 407, figures 270. D. Appleton & Co., New York, 1878.

The Naturalists' Directory for 1878, containing the names of the Naturalists north of Mexico, a list of Societies, etc. Edited by S. E. Cassino. 12mo, pp. 184. Naturalists' Agency, Salem, 1878.

Ferns of Kentucky. By John Williamson. 12mo, pp. 154, and sixty plates drawn by the author. John P. Morton & Co., Louisville, Ky., 1878.

Osteologie et Myologie des Manchots on Spheniscides par M. M. Paul Gervais et E. Alix. 8vo, pp. 48, pls. xxvi, xxvii. Paris, 1878. From the authors.

Illinois State Laboratory of Natural History. Natural History of Illinois. Bulletin No. 2. 8vo, pp. 92, 1 plate. Bloomington, Illinois, 1878.

The Palæontologist. N. P. James, editor. 8vo, pp. 8, No. 1. Cincinnati, July 2, 1878.

The Law of Population. Its consequences and its bearing upon human conduct and morals. By Annie Besant. 12mo, pp. 47. New York: Asa K. Butts, 19 Dey street, 1878.

On the Influence of the Advent of a higher form of life in modifying the structure of an older and lower form. By Prof. Richard Owen, F.R.S., etc. 8vo, pp. 421–430. (From the Quart. Journ. Geolog. Soc. of London for May, 1878.) From the author.

Remarks on New Zealand Fishes. By Dr. Albert Gûnther, F.R.S. 8vo, pp. 469–472. (From the Ann. and Magazine of Natural History, May, 1876.) From the author.

On a Collection of Reptiles and Fishes from Duke-of-York island, New Ireland and New Britain. By Dr. Albert Günther, V.P.Z.S. (Proc. Zoöl. Soc. of London, Feb. 20, 1877, 2 plates.) From the author.

Preliminary Notes on new Fishes collected in Japan during the Expedition of H.M.S. "Challenger." By Dr. A. Günther, F.R.S. (From the Ann. and Mag. Nat. History, Nov., 1877.) 8vo, pp. 433–446. From the author.

Account of the Zoölogical Collection made during the visit of H.M.S. "Petrel" to the Galapagos islands. Communicated by Dr. Günther. (From Proc. Zoöl. Soc. London, Feb., 1877.) 8vo, pp. 64–93, 3 plates.

Notice of two large extinct Lizards, formerly inhabiting the Mascarene islands. By Dr. A. Günther, F.R.S., etc. (From the Linnæan Soc. Journ. Zoölogy, Volume xiii.) 8vo, pp. 322–327. From the author.

Notes Sur les Schistes a Meletta de Froidefontaine. Par MM. Oustalet & Sauvage. (Ext. du Bull. Soc. Geol. de France. 2me Ser. t. xxvii, Janvier, 1870.) From the authors.

Proceedings of the Boston Society of Natural History. Vol. xix, part iii, May, 1877 to March, 1878. 8vo, pp. 223–334, plates 8, 9. Boston, May, 1878. From the Society.

Descriptions of new species of Invertebrate Fossils from the Carboniferous and Upper Silurian rocks of Illinois and Indiana. By C. A. White, M.D. (From Proc. Acad. Nat. Sci., Philadelphia, 1878.) From the author.

The ancient Outlet of Great Salt Lake. By A. C. Peale. (Am. Journ. Science, Vol. xv, June, 1878.) 8vo, pp. 439–444. From the author.

Descriptions of Seven New Species of Birds from the Island of St. Vincent, West Indies. By George N. Lawrence. (Ann. N. Y. Acad. Sciences, Vol. i, No. 5, 1878.) Pages 147–153. From the author.

Description of a new species of Parrot of the genus Chrysotis. By George N. Lawrence. (Ann. N. Y. Acad. of Sciences, Vol. i, No. 4.) Pages 125, 126. From the author.

Revista Meteorológica Mensual, Marzo, 1878. Also Boletin del Ministerio de Fomento de la Republica Mexicana, June, 1878. Mariano Bárcena, Director, Mexico, Mex.

Proceedings of the American Philosophical Society, No. 101, July 8, pp. 455, Philadelphia.

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GENERAL NOTES.

BOTANY.

INSECTS NEEDED TO FERTILIZE UTRICULARIA AND PYXIDANTHERA.—In a short paper read at the American Association, in Buffalo, in 1876, I showed some of the neat arrangements by which a cross-fertilization of flowers was secured in several species of several genera of plants. I now present an illustration of one of the best of these. It is the common bladderwort, *Utricularia vulgaris*, which is common in stagnant ponds. Aside from the peculiarity under consideration, there are several other things about the plant of especial interest.

Fig. 1 shows an enlarged front view of the flower with the lower tip pulled down. The lower tip of the stigma is much the larger, and when touched it bends up in a few seconds close against the upper lip of the corolla just under an arch-like projection. On visiting a flower for honey, an insect, as a honey-bee, can scarcely fail to hit the larger of the two stigmas. Farther on pollen is received on the tongue or jaws of an insect. None is likely to be left on the stigmas of the same flower, for by the

time the insect is ready to withdraw, the side of the stigma which

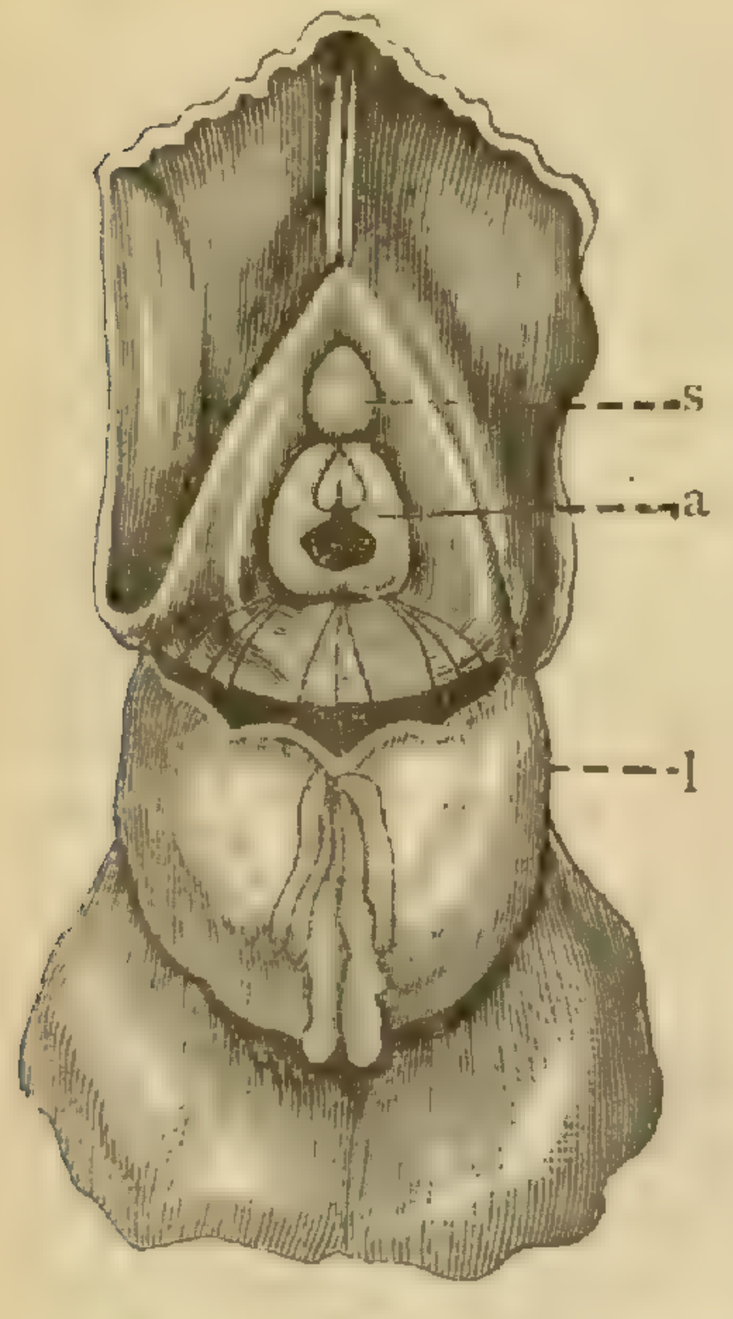


FIG. 1.—An enlarged front view of a flower of *Utricularia vulgaris*. *s*, outside of the larger sensitive stigma after it has closed under the ridge on the corolla. *a*, anthers. *l*, lower lip of corolla pulled down.

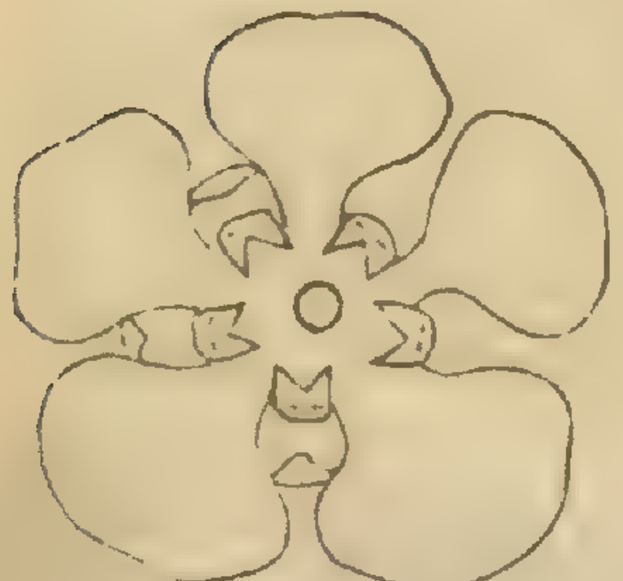
FIG. 3.—Side view of pistil still further enlarged, showing the larger stigma a few seconds after it has been disturbed.

FIG 2.—Side view of the same flower showing the position of the larger stigma before it has been touched by an object.

is ready to receive pollen is hidden or covered. Hardly any method can be more admirable for securing a cross-fertilization of flowers.

Some time in April I received from the pine barrens of New Jersey a large plant in flower of *Pyxidanthera barbulata*. This was placed near the window on a dinner plate containing some water. The plant continued to produce an abundance of fresh

Fig. 1.



Flower of *Pyxidanthera barbulata*, enlarged.

Two of the sepals are removed. The two-beaked anthers shown between the petals.

Fig. 2.

Oblique view of stamen, showing beaks and transverse opening in anthers.

Fig. 3.

Side view of stamen.

flowers for ten days or more. The small white flowers when

open look much like a small phlox, to which the plant is nearly allied. There are five stamens alternating with the lobes of the corolla, to which they are attached. The anthers are about as high as the stigma, towards which each one projects two short beaks. On pressing these beaks down with a pin, a mass of pollen oozes out of each transverse slit of the anther. After removing the pin, the beaks will again and again resume their places and the opening will close. After they were well open, I marked several fresh flowers and watched them two or three times a day for four or five days. In no case did any pollen escape from the anthers. These finally withered and shrunk up considerably, and the whole corolla, stamens and all, seemed to be lifted above the rest of the flower by the elongation of the calyx or some other cause.

This case seems to be dependent on insects for aid in fertilization. It is possible that fresh plants in their native place would not behave as did these sent by mail, but I think they would. If so, this queer plant is another of the hosts of plants which have a special contrivance by which insects are needed to aid in transferring pollen.—*Prof. W. J. Beal.*

WOLF AND HALL'S LIST OF THE MOSSES, LIVERWORTS AND LICHENS OF ILLINOIS.—This list appears in Bulletin, No. 2, of the Illinois State Laboratory of Natural History. It is simply a dry list, without any remarks such as would seem to be in place regarding variation, &c.; but will prove undoubtedly of use to local botanists.

ZOÖLOGY.[1]

INTELLIGENCE IN CHIMPANZEES.—Some observations recently made on the mental faculties of the pair of young chimpanzees (*Troglodytes niger*) in the Zoölogical Garden, indicate the possession by those animals of the power of ratiocination to a very considerable degree.

A looking-glass having been placed in the cage they proceeded to investigate the novel phenomenon presented to them, but without much success until one of them, being engaged at the moment in munching a crust of bread, appeared to be struck by a similarity in the occupation of himself and of the figure before him. Withdrawing the bread from his mouth, he looked first at it and then at its reflected image, and then proceeded to place it in various positions, watching carefully the figure in the mirror, until he seemingly became satisfied that what he saw was, in some manner to him incomprehensible, himself, after which he passed some time sitting in front of the glass watching his own motions with much satisfaction.

A snake being placed in the room the animals manifested great

[1]The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

terror, climbing at once to the top of the cage and uttering incessantly their peculiar cry of alarm. So great an impression was made on them that after the snake was taken away they remained aloft for fully two hours, and not even the sight of the dish and spoon with which they were familiar was enough to bring them down, although they gave evidence by their outstretched hands and their expressive faces that it would afford them great pleasure to have it handed up to their place of refuge; still they would not come down, and did not until their regular attendant, to whom they are much attached, came on the scene, when they promptly descended and embraced him fondly. He was then directed to place them near the glass front of the cage, and the snake was shown to them from the outside, but that which was so frightful at a distance of ten feet in the same room, lost much of its terrors when only six inches away but on the other side of an inch of plate glass; they merely uttered their *hoo-hoo* of displeasure and pointed at it with the forefinger.

To make certain that they had not merely become accustomed to its presence, it was again thrown through the door, when the two animals, panic stricken as before, fled wildly up the ropes.

In this connection an interesting fact was observed. Mr. Wallace, in "The Malay Archipelago," describing the habits of the orang, in Borneo, says, that when disturbed by the presence of a strange object, as a man, both the male and female ascend the trees, but that it is the female only who sounds the note of alarm and casts down fruit and branches to the ground. This would appear to be likewise the case with the chimpanzee, for when frightened by the snake the male laid down on the cross-beam where they took refuge, and only turned himself over occasionally to fix an eye on the enemy and to utter his expressive *hoo-hoo*, while the female placed herself directly over the snake, repeating constantly an entirely different sound, something like *whey-whey*, in a high shrill key, meanwhile leaning down towards the snake and violently striking against the beam with the palm of her hand. These actions are undoubtedly a part of the maternal instinct called forth in all animals with whom the female is charged with the duty of taking care of the young and protecting them from dangerous intruders.

In contemplation of the mental processes performed by the chimpanzees in clearly discovering their own identity with the figure reflected by the mirror, and in relying on the protection afforded by the glass front of their cage against their dreaded enemy, it is hard to see on what but the flimsy basis supplied by prejudice, can be founded such statements as that, for instance, made by Mr. Mivart, to the effect that the difference between the minds of man and the higher apes, "is a difference of kind and not one of degree." (Man and Apes, p. 149.)

The writer, for one, fails to see wherein these processes differ,

except somewhat in degree, from the lowest efforts of the brain of a savage; indeed it is doubtful if the undirected faculties, those given by nature alone, of a human child of the same age—about four years—would produce results of a much higher grade. When to these, however, is added, by the art of man, the faculty of language, the human infant develops with amazing rapidity into the man of intellect, leaving far behind its late rival which grows only into greater bulk and force of muscle, the growth of the individuals thus epitomizing into a few years the whole history of the vast progress and the brutish immobility of the two races which they represent.—*Arthur Erwin Brown, June* 20, 1878.

Is the Rocky Mountain Sheep Covered with Wool?—Two questions are very frequently asked of western hunters: "Is the 'bighorn' covered with wool?" and "Do antelopes shed their horns?" If a vote were taken on these two subjects both questions would probably be answered in the negative.

During a number of years I have had occasion to travel over the low country of the West, as well as through some of its most elevated portions. Within the latter I have often met with the Rocky Mountain sheep, or bighorn (*Ovis montana*). As the high mountains where these beautiful animals usually occur are not accessible during the cold seasons of the year, I never saw the sheep otherwise than covered with hair, somewhat resembling that of the antelope. It is neither so fine nor so straight as that of the deer, but very nearly of the same color. In the summer of 1877 my work carried me to the Wind River mountains, Wyoming Territory. On July 17th I found myself quietly resting on a rock, amid large fields of snow, at an elevation of about 12,000 feet above sea level. While studying the surrounding scenery I was aroused by the sounds of rapidly approaching steps. Looking up I saw four mountain sheep running towards me. At first I scarcely recognized the species of the animals. They were of a totally different color from any I had seen before, and seemed to have a very rough skin. By the time I had completed my observations the sheep (female) had done likewise, and were moving off in an opposite direction with considerable speed. A shot sent after their retreating forms wounded one of them, but all escaped.

July 25th a party of four of us ascended a high peak near the southern termination of the range, in north latitude 42° 40′ (approximately). As we reached timber-line, about 11,200 feet above sea level, we saw a band of more than one hundred mountain sheep. Several were secured by the aid of our rifles. Upon dressing them we found that the "hair" was shorter than usual—about three-quarters of an inch in length. It was apparently growing rapidly, and was pushing before it a layer of very fine *wool*, about half an inch in thickness. In other words, the sheep were shedding their wool. This latter is exceedingly fine, and of

a light gray color. Some portions of the body were already clear of it, but it still remained on the larger part thereof. This explained in a few moments the peculiar color and appearance of the sheep I had seen a week before. A fœtal animal belonging to this species, which I had occasion to examine in 1875, showed a similar character of its covering. The skin was no longer fresh when I obtained it, and the proof was not so positive as in this instance.

The second question is not so readily answered. During the summer of 1877 I saw several thousands of antelopes, and passed through regions over which they had roamed for years. There I found quite a number of hollow antelope horns, lying on the ground. Each time I made careful search, in order to discover other bones of the animal, but in eight instances could discover none. It may be that coyotes dragged the horns to the places where they were found, but in this case other portions, either of skin or skeleton, would probably have occurred near the spot. A young male antelope fell a victim to one of my bullets, and upon examination I found that one of his horns had been injured. A slight exertion, only, sufficed to remove the horn from its "core." If antelope do shed their horns, a supposition to which I incline, they probably do it at irregular intervals, and perhaps only as the result of disease or injury. Not being a professional zoölogist, I am unable to point out the affinities of these animals, which would render the shedding of horns either more probable or less, in accordance with their present taxonomic position.—*F. M. Endlich.*

(*Note by the Editor*). After several years familiarity with the prong-horned antelope in a wild state, I may say that I have never met with an undoubted case of shedding of the horn sheath. Shed horn-sheaths are not common where these animals abound, as they should be, were the phenomenon usual. Their appearance on the animal at times indicates that they may be shed, and I suppose that the evidence is sufficient that the shedding occurs. But it is not periodical nor even frequent.—*E. D. Cope.*

Discovery of two Remarkable Genera of Minute Myriapods in Fairmount Park, Philadelphia.—It has been my good fortune to detect *Polyxenes* and *Pauropus* in our splendid Park, thus adding two hitherto unnoticed articulates to the fauna of Pennsylvania. The former I regard as the *P. fasciculatus* of Say, and is about one-tenth of an inch long. Its detailed history is reserved for a future article. The *Pauropus* appears to be identical with *P. huxleyi* of Lubbock, at least after a most careful microscopical scrutiny of a number of specimens, I could find no character that would warrant specific distinction; the pyriform body between the two styles which surmounts the shorter of the two last segments of the antennæ being sessile as in the aforementioned species. The habitat was in the decayed roots of an old oak in

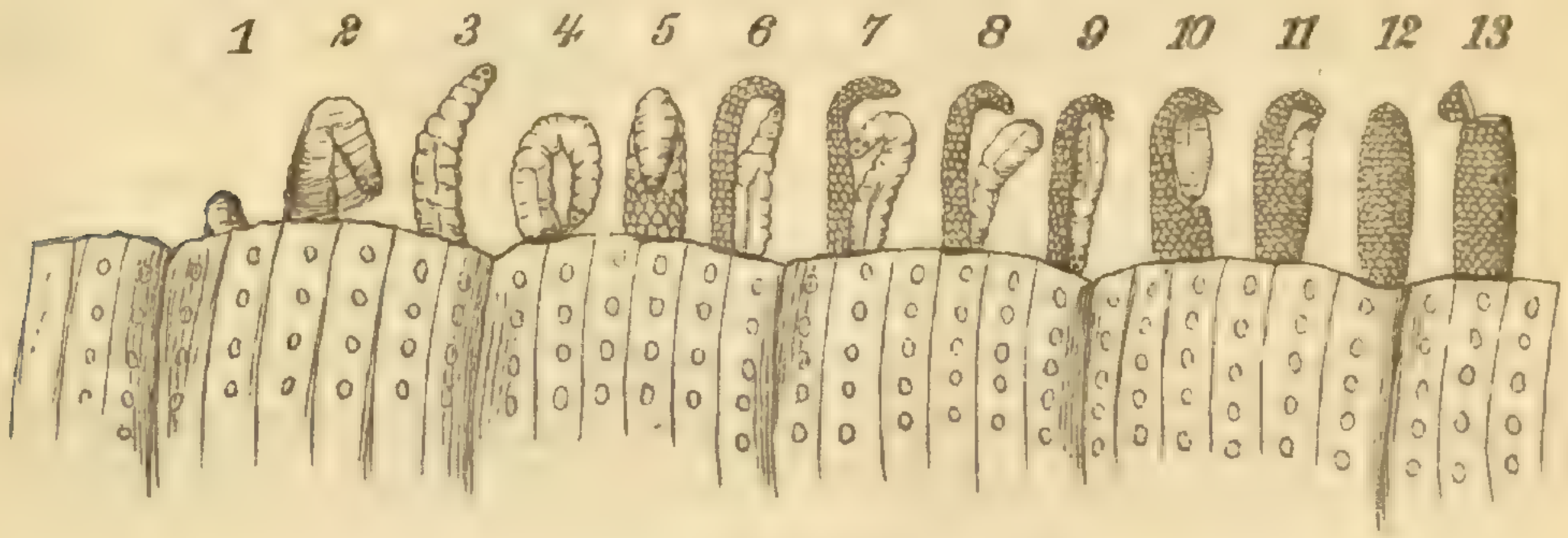
the passage ways and galleries of a nest of *Termites* or white ants, and I think it likely that this and similar situations will turn out to be their favorite haunts. The singular activity of the little creature as compared with that of the small *Collembola* and crustaceans which were its companions was very striking and rendered it very evident that we had encountered an organism which until then had escaped our observation. The little fellows when roughly handled rolled themselves up and "played possum," as do some Diplopods. They also seemed to be very sensitive to contact with a pointed style with which I frequently touched them, and which I think they perceived by means of the long lateral bristles of which there are four on each side as well as by means of the antennæ. Much more active and quick in movement than *Polyxenes*, resembling in this respect the Chilopods, I am inclined to think that they are undoubtedly *Myriapoda*. Also the fact that I found many specimens with but three and four leg bearing segments is also evidence that they moult several times, as do their immediate allies, in passing from the immature to the adult state. As Lubbock has found the spermatozoa, and also noticed most of the other facts here mentioned, I would merely state that I have been so explicit only because desirous of confirming what seems to me to be that naturalist's just conclusions in regard to its myriapodal affinity. The species which I have found is white and is about 1-25th of an inch in length, which renders it a good subject to try the eyesight of a collector. With a magnifying power of a thousand diameters the styles or bristles which terminate the antennæ are seen to be made up of a great number of superposed disks or rings, and I have been unable to decide whether they are mere annular processes encircling the central axis of the style, or whether they are separate segments, though the flexibility of the styles would indicate that they were segmented. The clavate hairs are in like manner annulated.—*Jno. A. Ryder.*

[The discovery of Pauropus (*P. Lubbockii* Packard) at Salem, Mass., was announced in the NATURALIST in 1870 (vol. iv, p. 621). *Polyxenus fasciculatus* Say is not uncommon about Salem, Mass., under the bark of trees.—*Eds.*]

MODE OF CONSTRUCTION OF THE COCOONS OF MICROGASTER.—The construction of the cocoon of Microgaster, one of the Chalcidians, may be best observed under a moderate magnifying power.

The caterpillars most likely to be infested with these parasites are the large green and reddish ones of *Philampelus*, found on the grapevine and *Ampelopsis quinquefolia*. If half a dozen of these larvæ, when nearly full grown, are placed under a bell glass and fed every morning with fresh leaves of the vine from which they were taken, one or more will most likely be found to be infested with the larvæ of Chalcidians.

The first appearance of the parasite is represented in Fig. 1. A warty excrescence appears on the back of the caterpillar, which slowly emerges until it is seen to be a larva enclosed in a delicate transparent membrane, as represented in Fig. 2. This it soon succeeds in bursting, and rising to its full length, balances itself a moment as in Fig. 3, then bending double it ejects from its mouth a glairy liquid, which instantly changes to silk and fastens



FIGS. 1–13.—Ichneumon (*Microgaster*) spinning its Cocoon.

the posterior end to the skin of the caterpillar, as shown in Fig. 4, side view. It now begins to spin its cocoon by attaching a silken thread to the silky mass by which it had previously fastened itself to the caterpillar, and forming a series of loops of uniform size, first from right to left and then back again from left to right, as represented in the front view, Fig. 5, and better in the enlarged view Fig. 5 *a*, the arrow-heads showing the direction in which the head of the larva moved while forming the loops. The ends of the series, numbered 1, 2, 3, 4, are fastened to the edges of the ventral side of the body, which thus serves as a measure of the width of the cocoon and also acts as a support for the frail fabric in the first stages of spinning. After the larva has fastened the fabric as far up on its ventral surface as it can, conveniently, it then begins to spin free, as shown in the side view, Fig. 6, where it is represented as just completing the first half of its cocoon which resembles in form a slipper. This accomplished, the larva ceases to spin for the time being, bends its head, as in Fig. 7, towards its ventral surface and pushes the half cocoon free from its body. The form of the silken fabric enables it to stand unsupported, while the larva, sliding its head down to the base, holds on firmly until it swings it posterior end into the toe of the slipper.

FIG. 5 *a*.

Fig. 8 shows it in the act of changing end for end, and in Fig. 9the larva is seen erect, beginning at the base to complete the

other half of its cocoon. Fig. 10 shows the larva contracting its body as it spins upward for about half the length of the cocoon, when it again changes end for end, as shown in Fig. 11, where it is beginning at the upper part to unite the two sides, finally enclosing itself as represented in Fig. 12.

It may now be seen, under the microscope, through the meshes of its cocoon actively engaged in lining the interior with layers of very fine silk ejected from its mouth in great abundance. One half of the cocoon is first lined by a forward and back movement of its head, and then reversing its position it lines the other half in a similar manner.

In one case the larva was disengaged from the skin of the caterpillar, after beginning its cocoon. It, however, began again, and spun a portion while lying on the table. This was removed, when it began a third time and completed its cocoon.

In about ten days the insect made its appearance through a hole in the upper end, as represented in Fig. 13. The top was eaten off in a perfect circle and hung by a few threads, so as to resemble a lid as it was thrown back.

One caterpillar observed had between three and four hundred cocoons on its back and sides, and another was dissected after more than thirty larvæ had escaped, and a hundred and thirty were discovered in the soft integuments of the back.

The figures from 1 to 13 are magnified five diameters, but in order to observe the spinning of the cocoon a power of fifty is required.—*John P Marshall.*

ARGONAUTA TUBERCULOSA.—It should have been reported long ago that I had discovered a very fine and perfect shell of medium size, of the above, which was picked up August, 1876, from the surf washing at Point Comfort, New Jersey. This, in addition to the one obtained alive at Long Branch the same month and year, which I described in the AMERICAN NATURALIST for April, 1877, p. 243, increases the probability that the geographical range of the species is enlarging. I am satisfied now that both are the same species. Considering the frailty of the shell, and its exquisite perfection, no doubt can be held that its tenant was alive not many hours before the finding. The sheet containing drawing and measurements is mislaid, and the vain hope to find it has caused the delay in this communication.—*S. Lockwood.*

ANTHROPOLOGY.[1]

ON THE PUNISHMENT OF PROSTITUTION AMONG THE ABORIGINES.—During the time of my trip through Arizona several years since, as a member of the U. S. Topographical Expedition for the Exploration of that region, I had an opportunity of seeing several

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

Coyotèro Apachè women who bore the brand of punishment, inflicted for prostitution. As the custom was then but seldom practiced, and has probably fallen entirely into disuse by this time, it may not be amiss to describe it. In his "Notes on the 'Tonto' Apachès," (Smithsonian Report, 1867, 417–419), Dr. Smart says, "he saw women who had the cartilaginous portion of the nose cut off, and this was apparent only amongst those who had any pretensions to beauty."

This statement was read at the time of its publication without giving it further thought, than that it might be merely a custom peculiar to the tribe, for some reason similar, for instance, to head-flattening, tatooing, or perhaps to puncturing the lips, or ears. But, when upon inquiry I was informed that all those who were so disfigured had been guilty of adultery, it appeared strange that so severe a punishment should have been in practice, and confined to so small an area, as none of the tribes immediately surrounding the territory of this sub-tribe of Apachès are known ever to have imitated them in this respect. But we find it to have been in practice among several other tribes outside of Arizona. In his allusion to this custom as practiced by the Commanches, Gregg says (Commerce of the Prairies, 1844, II, 308. 309), "The husband seems to have complete power over the destinies of his wife and children. For adultery, his punishment is most usually to cut off the nose or ears, or both, and he may even take the life of his unfaithful wife with impunity. The squaw who has been mutilated for such a cause is, *ipso facto*, divorced, and it is said forever precluded from marrying again." In reference to this tribe, Bancroft quotes (Vol. I, p. 515, *Author's Copy*) from the "*Revista Cientifica*" (I, 57), "Las faltas conjugales no se castigan por la primara vez; pero á la segundo el marido corta la punta de la nariz a su infiel esposa, y la despida de su lado."

Gregg (*Ibid.* p. 308) also states that "this custom prevails among the Creeks to the present day, and was anciently practiced by other southern nations. 'Among the Miami's,' says Father Charlevoix, 'the husband has a right to cut off his wife's nose if she runs away from him.'"

Captain Roman's says that this custom prevailed among the Indians inhabiting Florida. (Concise History of East and West Florida, 1775, p. 98). Bancroft (II, 466) says that in Itztepec (Mexico) "the guilty woman's husband cut off her ears and nose, thus branding her as infamous for life." (Las Casas. Hist. Apologética, MS., cap. ccxiii; Mendieta *ubi sup.*).

"Among the Miztecs," says Bancroft (II, 466), "when extenuating circumstances could be proved, the punishment of death was commuted to mutilation of ears, nose, and lips." (Herrera, Hist. Gen., dec. III, lib, III, cap. xii.)

This singular punishment extended far down into Central America, but among many of the races inhabiting that country, death was the penalty.

In Nicaragua the guilty wife was repudiated, while the guilty man was severely beaten with rods by the woman's relations. In regard to punishing the guilty man, the Egyptians had a similar custom. Diodorus Siculus says (Lib. I), "In case of adultery, the man was to have a thousand lashes with rods, and the woman her nose cut off." This seems a strange similarity, and I doubt not that many others could be found who practiced this custom among their respective tribes.—*W. J. Hoffman, M.D.*

THE DIMINUTIVE MOUNDS of Oregon Indians alluded to in the May number, page 322, can be seen and investigated at the present day near the former homes and haunts of the several Kalapuya tribes, although the majority of the natives were removed over twenty years ago (shortly after the Government treaty of 1855) to the Grand Ronde Reserve in Yamhill and Polk Counties. The Tuálati name for these earthworks is "*atúdship.*" Many of them are visible about six miles west of Forest Grove, on the eastern slope of a wooded hill, which slants down towards McCloud's Farm and the track of the narrow-gauge railroad. Low elliptic or oblong ditches include four five, six, or even seven of these rounded, parallel moundlets. This location was the ancient home of the Tuálati, or, as they call themselves, Atfálati tribe, who derived a portion of their daily food from the "wild potatoes" (or *wápatu* in Chinook jargon) growing at the bottom of the neighboring Wápatu Lake. It is the root or bulb of the *Sagittaria sagittifolia* and was gathered by the women of the tribe, who caught it between the toes, or by pressing both feet together, and had to stand in water up to the waist all day during the ripening season.

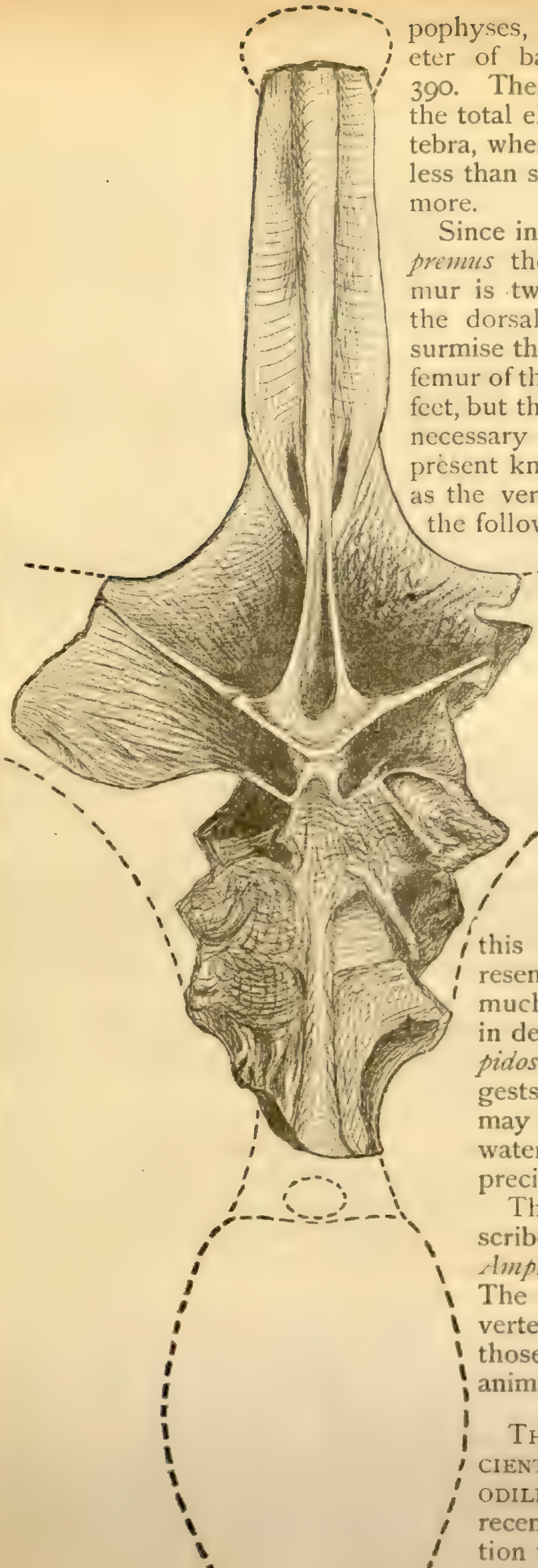
Although the custom of throwing up *atúdship* is gradually disappearing among the Indians on Grand Ronde Reserve, some mounds of this description are still to be seen on a high hill north of the agency buildings. On this mountain top they awaited the rise of the sun after having exerted themselves during the night in carrying up-hill heavy rocks in Sisyphus fashion, and rolling them down again. Other hillocks are thrown up in the hush of night by the female portion of this Indian community, who seem more interested than the males in keeping up this antique custom of their forefathers, on a flat-topped eminence about one mile east from the seat of the Grand Ronde Agency.—*A. S. Gatschet.*

ATTENTION is called to the following titles of papers and separate publications: Les sepultures de l'âge du renne de Solutre, Louvain, 1878, 54 pp., Extrait de la Revue des questions scientifiques, by Adrien Arcelin; "Ethnographic Parallels and Comparisons," Dr. Andree, Stuttgart (the object of this publication is to bring together from all parts of the world evidences of the existence and use of the same implement or custom, as, for instance, meas-

ures of value, mothers-in-law, the umbrella as a mark of dignity, &c.); Die Ethnographie Russlands, Erganzungsheft 54 to Petermann's *Mittheilungen;* Die Erhaltung der Turkei und die Völkercultur, *Das Ausland*, 14; Through the Dark Continent, Henry M. Stanley, Sampson, Low & Co.; Anciens ateliers de taille de silex dans le chott de Ouargla (Sahara Occidental), pp. 104–189 dans le Bulletin de la Société Polymathique de Morbihan, C. de Cadoudal; Studii anthropologici ed etnografici i sulla Nuova Guinea, Firenze, 1877, 82 pp.; Die Gastfreundschaft auf niederen Culturstufen, *Das Ausland*, 15; Considerations sur les différents âges de la pierre: Reponse aux objections faites au congrès de Budapest, Dr. H. Jacquinot (Nevers), 1877, 16 pp.; Ueber prähistorische Bauart und Ornamentirung der Menschlichen Wohnungen, Dr. M. Much, *Gæa*, 4th Heft; On the Origin and Growth of Religion, Max Müller, *Contemporary Review*, May; L'ethnologie et le dixiéme chapitre de la Genèse, dans la Revue des Questions Historiques, t, xxiii, 1878, 64 pp., Louis Rioult de Neuville; Ein cutlurgeschichtlicher Roman, *Das Ausland* 15.

GEOLOGY AND PALÆONTOLOGY.

A NEW SPECIES OF AMPHICŒLIAS.—I have recently received from my indefatigable friend, Mr. O. W. Lucas, the almost entire neural arch of the vertebra of the largest saurian I have yet seen. It was found in the Dakota formation of Colorado, near Canyon city, in the same bed that has thus far produced the known species of *Camarasaurus*, *Amphicœlias*, *Hypsirophus*, etc. In the extreme tenuity of all its parts, this vertebra exceeds those of this type already described, so that much care was requisite to secure its preservation. It exhibits the general characteristics of the genus *Amphicœlias*, in the hyposphen, antero-posteriorly placed neural spine, and elevated diapophysis for the rib articulation. The diapophyses are compressed and supported by a superior and inferior, and anterior and posterior, thin buttresses, separated by deep cavities. As compared with the *Amphicœlias altus*, this reptile differs in the greater elevation and attenuation of the neural spine, as well as its different form; also in the generally more laminar character of its buttresses and walls The double rib of the anterior border of the spine of the *A. altus* is here represented by two laminæ which extend on each side, so as to give a horizontal section of the spine a T shape. The posterior zygapophyses have less lateral expanse than in *A. altus*, but they continue as horizontal laminæ with a deep cavity above and below: their superior surfaces contract into two ridges, which are separated by a deep groove. These ridges, unlike the anterior ones, approximate to each other closely on the border of the spine. The summit of the spine is wanting. The measurements are: total elevation of neural arch preserved, 1500 m.; elevation of posterior zygapophyses, 585; transverse expanse of posterior zyga-



Posterior dorsal vertebra of *Amphicælias fragillimus*, $\frac{1}{10}$th natural size.

pophyses, 190; vertical diameter of base of diapophysis, 390. These figures show that the total elevation of this vertebra, when complete, was not less than six feet, and probably more.

Since in *A. altus* and *C. supremus* the length of the femur is twice the elevation of the dorsal vertebra, we may surmise that the length of the femur of this animal was twelve feet, but this is of course not a necessary consequence of our present knowledge. But so far as the vertebræ are concerned the following rule is without exception among the Saurians of the Dakota epoch: It is, that *the size of the vertebra is in direct proportion to the attenuation of its walls.* This latter character, as seen in this and other species, resembles nothing so much as what is seen in deep sea fishes, as *Alepidosaurus*, etc., and suggests that these beasts may have walked in deep water and browsed on precipitous shores.

The species above described may be called *Amphicœlias fragillimus*. The dimensions of its vertebræ much exceed those of any known land animal.—*E. D. Cope.*

THE RELATIONS OF ANCIENT AND MODERN CROCODILES.—Prof. Owen has recently directed attention to the adaptive character of the modifications of structure which have

taken place in the course of development of the crocodilian order. These changes consist in the advance forwards of the external nares, the more posterior location of the internal nares, the increasing irregularity of the alveolar borders and sizes of the teeth, and the change from amphicœlous to procœlous vertebral articulations.

Prof. Owen proposes that these changes were concomitants of a gradual restriction of aquatic and increase of terrestrial habits, and the gradual diminution of a purely fish diet, and the adoption of land animals as food. The capture of the latter and their retention below the surface of the water until devoured, directly relate to the uses of, and hence necessity for, the new structures in question.

A NEW DIADECTES.—This very singular genus[1] of supposed Saurians, is represented by a third species from the Permian of Texas. The teeth are more completely molar in their character than in the species already described, being in the unworn condition as broad across the crown, as the latter is high. In the transverse direction the crowns are two and half times as long as wide. The extremities are rounded, and there is a median cusp extending across the crown; on each side of the cusp, the face of the crown is slightly concave. The enamel is strongly but finely wrinkled. The tooth series terminates abruptly in a tooth of half the transverse extent of the penultimate. Length of space occupied by penultimate and ante-penultimate teeth M. .021; length of base of penultimate .010; width of do. .024; elevation of crown, least .006; do. at cusp, .009.

This species is larger than those heretofore described, and the teeth are adapted for crushing harder bodies—having perhaps a use like those of *Placodus* or *Pycnodus*. It is called *D. molaris*.

GEOLOGY OF THE BRITISH ARCTIC EXPEDITION.—Geological investigation in the Polar regions is beset with difficulties of so grave a character that very few collections have hitherto been brought home by Arctic explorers, and these have necessarily been meagre. During Sir George Nares' expedition, however, special attention was paid to geological observations wherever practicable, and Captain Fielden thus contrived to collect more than two thousand specimens of rocks and fossils. He also had the good fortune to find his collections brought home in safety—a fact worth mentioning, because some other fine collections have been lost to science through the mishaps incident to Arctic traveling. The recently formed collections, and the results deduced from their study, were lately laid before the Geological Society. In working out the stratigraphical results, Captain Fielden has had the benefit of Mr. de Rance's aid, and in the palæontological department that of Mr. Etheridge. The fundamental rocks

[1] American Naturalist, 1868, May, p. 327.

of the area under examination consist of gneiss which is probably of Laurentian age, the Canadian rocks extending into Polar area. These are followed by unfossiliferous slates and grits, known as the Cape Rawson beds, which are evidently older than the fossil-bearing Upper Silurians. It is proved, indeed, by the recent expedition, that Lower Silurian rocks exists in Grinnell and Hall Lands, thus disproving Murchson's view that the Polar area was dry land during the Lower Silurian period. Sixty species of fossils have been determined by Mr. Etheridge, ranging from the Lower to the Upper Silurian, and including some characteristic forms of Llandecilo and Wenlock age. The cream-colored dolomites found in abundance by some of the previous explorers are believed to represent the whole of the Silurian, and perhaps part of the Devonian period. True marine Devonians have been discovered for the first time in Grinnell Land. Here, too, the carboniferous limestone was found rising to a height of 2000 feet. This formation extends to the most northern point yet reached, and probably strikes beneath the Polar Sea to Spitzbergen. About thirty species, chiefly Brachiopods and Polyzoa, were procured from the carboniferous limestones of Cape Joseph Henry, the most northerly of the twenty localities from which fossils were collected.

Mr. Etheridge points out the greater resemblance of the Arctic palæozoic fauna to that of America than to that of Europe. No mesozoic rocks are known until we reach the cretaceous strata, which are represented in Greenland by plant-bearing beds that indicate by their fossils a warm climate something like that of Egypt at the present day. The vegetation of the miocene beds in the Arctic regions points to climatal conditions about thirty degrees warmer than those which at present prevail. The miocene beds of Grinnell Land contain the common fir (*Pinus abies*) the birch, poplar, and other trees similar to those which occur in Spitzbergen. A seam of miocene coal, thirty feet in thickness, was discovered by the expedition at Lady Franklin Sound.—*Academy.*

GEOGRAPHY AND TRAVELS.[1]

Colonel Prejevalsky's Third Journey.—This distinguished Russian explorer has sent, under date of August, 1877, to the Russian Geographical Society, a report of a third journey in Central Asia. Translations of this report have been made by Dr. Petermann, published as a supplement to his *Mittheilungen*, with the original route maps and an Uebersichts-Karte of his journeys from 1872 to 1877; and also by Dr. R. Kiepert for the *Globus*. At the meeting of the Berlin Geographical Society, on the 6th of April last, Herr Von Richthofen read a very interesting paper upon the results of this journey. Colonel Prejevalsky was most fortunate

[1] Edited by Ellis H. Yarnall, Philadelphia.

in making this exploration at a period when this region was held by Yakub-beg, at that time the ruler of Kashgar, who was assassinated about the middle of last year, and his kingdom overthrown by the Chinese. Neither a year earlier, nor at the present time, would such an expedition have been practicable. Leaving Kuldja, August 12th, 1876, he traveled in a general south-east direction, crossing the eastern Tian-Shan by a pass 9800 feet in height, called the Narat, and found that the rain-fall was plentiful on the north side where are abundant forests and game, but wholly deficient on the south side. He then entered upon an extensive plateau called Yuldus, about 8000 feet above the sea. Both in birds and mammalia the Yuldus is very rich. By a pass 9300 ft. in height he descended from this plateau, and before entering Korla (2600 feet, population 6000), on November 4th, 1876, he left behind the last spurs of the Tian-shan. Proceeding to the Valley of the Tarrim he passed a stony strip of country, probably the shore of a former sea, while beyond is a desert consisting of clay and sand. The clay is impregnated with salt, and on both sides of the Tarrim salt marshes are found. On December 18th he arrived at Charchalyk, between the Lob-Nor lake and the lofty mountains of Altyn-tag. He explored the northern slope of this range, which rises precipitously, as an immense wall, to the height of 12,000 to 14,000 feet. South of the Altyn-tag, it was learned, is a plateau of 13,000 feet in height, and beyond, other ranges of mountains, forming an enormous mountain chain covered with perpetual snow. The Tarrim and Lob-Nor desert is the poorest and most desolate region Prejevalsky had ever set eyes on. He then explored the northern face of the Altyn-Tag range which forms the northern escarpment of the Tibetan plateau. The mountains are about 14,000 feet high. These mountains, says the account in the *Geographical Magazine*, are characterized by great sterility, and it is only in the valleys and ravines that vegetation grows; yet, nevertheless, large swarms of locusts are here to be seen. In the summer of 1876 they committed great ravages, and rose to a height of 9000 feet in the mountains. The climate of the Altyn-Tag is characterized on its northern side at least by great cold and little snow. In summer, according to the natives, it rains frequently and is very windy. In this mountain region and the adjacent Kum-Tag desert there are a few wild camels, which twenty years ago were said to have been very common. They seek the upper valleys of the Altyn-Tag in the summer and the most inaccessible deserts in the winter. Their sight, sense of hearing and of smell are exceedingly quick, a striking contrast to the domesticated camel, which is just the opposite. Lob-Nor lake is supplied by the Tarrim river; it is shallow, overgrown with reeds and is for the most part a morass, the water being fresh, though there are salt marshes all around it. The inhabitants about the lake speak a language most like that of Khotan. The

exploration was made just before the invasion of the Chinese, the inhabitants being of Aryan stock and of the religion of Islam.

The Lob-Nor lake is elliptical in shape, is 90 or 100 versts in length and 20 versts in breadth. It is 2200 feet above the sea level. It is much overgrown with weeds, and, though surrounded by salt marshes, the water is clear and sweet.

The flights of birds of passage which make a resting-place of Lob-Nor in their migrations, were very carefully observed by Prejevalsky, millions during February passing on their way across the desert. None came from the south across the lofty and cold plateau of Tibet, but cross it where it is narrowest, *i. e.*, in the direction of Khotan. The region explored by Prejevalsky lies to the north of Tibet. The article is illustrated by a map

On all sides, this great depression, forming a basin surrounded by the loftiest mountains of the globe, has been approached by the English and Russians, but never visited by any scientific or intelligent travelers. On our maps this basin of the Lob-Nor has been placed far beyond the great central mountain range of the Kuen-Lun, and nearer the Tian-shan system; whereas, according to Prejevalsky, it lies at the foot of the Altyn-tag, which he believes is, without doubt, the northern rampart of that mighty region of mountain and plateau, whose southern boundary rises over the plains of India, and thus extends in breadth over nearly thirteen degrees latitude—a distance equal to that from Naples to Hamburg.

In concluding his examination of the results of this very successful exploration, Herr Von Richthofen remarks that new discoveries bring new problems, as, for instance, the existence of a body of fresh water in a spot where all former accounts tell of a great salt sea, and where every theoretical conclusion would confirm us in the belief that such was the case. Count Béla Szécsenyi has already departed from Shanghai with the expectation of reaching the southern side of the Tarrim basin.

Meanwhile Col. Prejevalsky left Kuldja on August 28th, 1877, for Guchen, intending to penetrate into Tibet by Hami, Tsaidam and the upper course of the Yang-tse. Unfortunately, after reaching Guchen, sickness obliged him to return to Zaissan, and he is now on his way home to St. Petersburg.

A more recent journey by Captain Gill, in Western China, supplies, states the *Geographical Magazine*, an interesting confirmation of the apparent existence of a belt of exceedingly moist region between the Tibetan plateau and the lands encompassing it on its north-eastern and eastern sides. Prejevalsky, in his "Mongolia and Tangut Country," notices this feature while ascending the mountains south-west of Tajing; the Père Armand David noticed it during his residence at Mupin, north of Ching-tu-fu; Mr. Cooper, while making his way from the last-named

place into eastern Tibet; and Captain Gill's testimony now supplies us with a link between the observations of Prejevalsky and David, as he speaks of the wonderfully moist and semi-tropical character of the vegetation on the eastern side of the plateau, between the valleys Sung-pan-ting and Ling-ngan, on the extreme northern border of the province of Se-chuen.

Dutch Arctic Expedition.—The Willem Barentz, a two-masted schooner of eighty tons, built expressly for this service, with a crew of fourteen men, three officers, a zoölogist, a doctor, a photographer and eight sailors, sailed from Ijmuiden on the 5th of May, upon what may be regarded as an experimental voyage to Jan Mayen Island, thence to Spitzbergen, examining the edge of the ice en route, and calling at Amsterdam Island. Afterwards they hope to visit Novaya Zemlya and the Barentz Sea, returning home in October. Deep sea soundings will be made, and observations taken of the fauna, and flora; strength, and direction of currents; in magnetism, and meteorology. The expedition is supported by the contributions of Dutchmen.

Geographical News.—The last (June) number of Petermann's *Mittheilungen* contains a very interesting account of the application of the process of helio-gravure, by the Austrian Military Geographical Institute, to the production of the new maps of the Austro-Hungarian Empire. The maps are prepared on a scale of 1-60,000, and reduced photographically to a scale of 1-75,000. The (sun) engraving upon copper by the new process requires only about four weeks, whilst the engraving by hand would need forty-two months. The first sheets of this new map were issued in 1873; and, at the end of 1877, 271 were published, and it is expected that the whole number (715) will be completed within 10 or 12 years from the commencement of publication; whereas by the usual method a period of fifty to sixty years must have elapsed before the accomplishment of the work. The cost of the new process is only one-fourth that of the old. As regards the artistic appearance of these maps a specimen given in the *Mittheilungen* is most favorable; the impression being clear and sharp, and likely to deceive even an engraver.

The first volume of Dr. F. Ratzil, on the Geography of the United States, relating to physical geography, has lately been published. A second volume, on Social Geography, will next appear.

The *Geographical Magazine*, for June, gives the results of Nares' Narrative of a Voyage to the Polar Sea during 1875–76. Also a very complete map of the African Lake Region, with a notice of the advance sheets of Stanley's book. The map marks an era in African cartography. The review closes with this paragraph "Great as the value of Mr. Stanley's geographical research-

es are, and absorbing as is the interest excited by his narrative, we are inclined to attribute equal importance to the ethnological portions of his first volume. He has been most assiduous in collecting and arranging information respecting the habits and modes of life of the people, their arts and manufacture, and his account of the kingdom and people of Uganda, especially, is most valuable."

Mr. Alfred R. Wallace writes to *Nature*, June 20, 1878, to correct an error "in almost every detailed map of Australia, including some of the latest," consisting of a note placed at the head of the Alligator river in about S. Lat., 13½°, and E. Long., 133°—"steep walls, 3800 feet." He shows the absurdity of the existence of such precipices in a country where there are no important mountains, and only moderately elevated plateaus, and the fact that the supposed authority for the remarks, *Leichardt's Journal*, contains no such statement.

The failure of Congress to make an appropriation for Captain Howgate's Expedition to the Arctic regions, will compel Captain Tyson and his advance party, sent out last year, to return, as they were instructed to do, if the main expedition did not arrive at Disco by the latter part of August.

From dispatches to the *New York Tribune* and the Philadelphia *Press*, we learn, that this season Major Powell's labors will be mostly within the limits of Northern Arizona and Southern Utah. He expects to survey the region south of the grand cañon of the Colorado river, including the plateau country where the Moqui towns are situated. Of the seven rectangular sections (containing about 12,000 square miles each), included in his field of labor, maps of four have been completed, and it is hoped to complete the remaining three this year.

Dr. F. V. Hayden's corps will be engaged in Idaho and Montana. The area to be surveyed includes the Yellowstone National Park and the country lying to the south and south-east about the head of the Green, Snake, and Mud rivers. This will be an extension of the work of last year. Within this area is what is regarded as the true apex of the continent, its three greatest rivers, the Missouri, the Columbia and the Colorado rising in a peak in the northern end of the Mud River range. Lieutenant Wheeler's corps will be divided into three sections known as the Colorado, Utah and California sections.

The Colorado section will carry on its work chiefly in New Mexico, along the valley of the the Rio Grande to the Mexican border, and between that and the Pecos. The Utah section, owing to the Indian troubles, will be transferred to California, and will operate along the Sierras, to join the triangulation from the base of Virginia City, to that from the base of Los Angelos to the north and east. The California section will move north from Fort Bidwell, and will examine an area of 16,000 square miles into

the Columbia River basin. Another portion will move south from Carson, Nevada, and occupy triangulation points on the Sierras, and survey a portion of the range south of Mono Lake. A party is assigned to the Washoe mining region.

The Atlas of Colorado has now been completed by the U. S. Geological Survey, and gives the results of the labors of Dr. F. V. Hayden, and his corps, in geography and geology.

Colorado is now better known topographically than any other State.

In an article in the *Geographical Magazine*, on the productive zones of Russia in Europe, five of these regions are enumerated. There are, starting from the north, the *tundras*, then the forest and agricultural region (forming three zones), and the steppes. The *tundras*, those bare, damp Arctic wastes, are as a rule to be found between the Arctic Circle and the Polar ocean. They are frozen in winter and generally thaw to the depth of a foot or so in summer. Turf moss (*Sphagnum*) and reindeer moss (*Cladonia rangiferina*) are both to be found, and the latter is a product of economic importance, though in eight or ten days a herd of reindeer will generally exhaust a pasture of it. These animals yield so little milk that it takes at least a hundred of them to support one family. The entire area of the tundras in Europe amounts to about 144,820 square miles (English).

The two-masted schooner Eothen, of 102 tons, a sixteen-year old whaling vessel, recently refitted, sailed from New York on the 19th of June for Repulse Bay. She has on board the members of the Franklin Search Party, consisting of the commander, Lieut. Frederick Schwatka, U. S. A., Col. W. H. Gilder, Joseph Eberling—"Esquimaux Joe," of the Polaris Expedition,—Henry W. Klutchack and F. F. Melvers. At Repulse Bay they are to be reinforced by seven Esquimaux, and, as soon as there is sufficient snow, they go by sledging to a point near Cape Engelfield, where they expect to find a cairn containing relics of the Franklin expedition. They are to return during the winter of 1879–1880 to Repulse Bay. They take with them a valuable equipment of scientific instruments and are directed to take daily observations. Dr. John Rae, in a letter to Chief-Justice Daly, President of the American Geographical Society, published in the *New York Herald*, again expresses his disbelief in the existence of this cairn for the following reasons: (1.) That it is most improbable that any of the crew of Franklin's ships should have reached the locality mentioned, situated a distance of 300 miles over the very rough and partially open ice of Boothia Gulf and where no aid could be obtained. (2.) That in 1854, when he visited the regions between Repulse Bay and Boothia Gulf, he examined the Esquimaux of this region, but heard nothing of the existence of this cairn, although they knew of the cairn erected by him near Cape Englefield in 1847 and of the cache left by

Ross at Victoria Harbor in 1832. (3.) Capt. Hall, in 1868, was within thirty miles of the reported position of the cairn, but heard nothing of it.

MICROSCOPY.[1]

MICROSCOPICAL SECTION, TROY SCIENTIFIC ASSOCIATION.—A regular meeting of this Society was held on Monday evening, May 6th, the Chairman, Dr. R. H. Ward, in the chair.

Dr. Ward gave a discussion of some recent experiments in microscopic ruling, an account of which will be published shortly. Rev. A. B. Hervey, Vice-Chairman of the Section, gave a very clear summary of the classification of algæ by means of fructification, and illustrated the six principal groups into which the Red sea-weeds are divided by the following preparations: No. 1, *Ceramium rubrum* Ag., showing in its various stages of development, the fruit produced by the simple subdivision of the cell-contents of a fructified mother-cell; No. 2, *Callophyllis variegata* Ag., having the nucleus of the cystocarp compound, and the masses of spores separated by intervening sterile cells; No. 3, *Plocamium procerum* Ag., from the highest order in the third series, the spores being produced by the gradual development of bead-like strings of small cells, or "spore threads," arising from a common base or centre and often branched, and when fully developed, filling the cystocarp with a mass of sub-angular spores, all the cells of a given spore-thread appearing to develop simultaneously, but some of the threads in these sections, not having been fecundated and developed, appearing in their original state and form; No. 4, *Curdiæa laciniata* Harvey, showing characteristic fruit of the series where a mass of fine, closely packed, moniliform "spore threads," arising from a basal placenta, form the spores by the successive ripening and falling off of the end cells of the fecundated threads; No. 5, *Gelidium cartilagineum* Grev., illustrating the series having an immersed cystocarp, a placenta central as in this species or more frequently basal or parietal, and club-shaped spores developed at the end of very short spore threads; and No. 6, *Polysiphonia fibrillosa* Grev., having the cystocarp external and somewhat highly developed, and the spores large and club-shaped. The specimens were mounted in sea-water and glycerine, by the instantaneous method described in the May number of the NATURALIST, and showed the typical fructification of the different series with great distinctness. After study and discussion by the section, the series of slides was tendered as a special box to the "Postal Club."

A regular meeting was held Monday evening, June 3d, Dr. Ward in the chair. The chairman presented a box of slides prepared for the section by Mr. C. C. Merriman, of Rochester, a corresponding member. The slides were mainly the result of Mr.

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

Merriman's scientific work during a recent visit to the Bermudas, and were prepared with some originality of method, and with exquisite workmanship. After study of the objects, a vote of thanks was passed to Mr. Merriman for his donation.

Mr. C. E. Hanaman made some remarks in regard to the methods he had found most convenient for cleaning and handling slides and cover-glasses.

For cleaning slides as received from the hands of the dealers, a solution which has long been used by photographers for cleaning their negative plates and glass vessels, is as efficacious as the nitric acid bath, and wholly free from its disagreeable odors. The mixture consists of a cold saturated solution of bichromate of potash in water, to which about one-eighth its bulk of strong sulphuric acid is added, the mixture being made in a porcelain or thin glass vessel, as the heat evolved would be likely to break a bottle, and the vessel being kept outside a window until the mixture is cool, after which no more injurious vapor will be given off, and the liquor will be ready for use. A gross or two of slides may be cleaned in an incredibly short time by sliding them one by one into a porcelain vessel containing some of this liquid, tilting the vessel about a few moments to cause the liquid to flow through the mass, and then pouring off the liquid and placing the vessel under the stream from an open tap for a few minutes. They are then wiped dry with soft linen cloths, and spread upon a clean sheet of paper, each slide being gently breathed upon on both sides, and the most perfect surface, which exhibits the most perfect film of moisture, being placed downwards. They are then centered on a self-centering turn table, upon the upper or poorest side, by a dot and a ring of india ink; they may then be placed on their edges in a box or drawer, and kept from contact by little strips of blotting paper placed between their ends.

The cover glasses, after being treated with the cleaning liquid and thoroughly washed with distilled or filtered water, are picked out with the forceps, one by one, and dried by laying each on one corner of a soft linen cloth on the table, and gently rubbing first one side and then the other with another part of the cloth. The cloths (worn out handkerchiefs, &c.), used for this purpose should be first cleaned by boiling with carbonate of soda and rinsing in hot filtered or distilled water. If the covers are finally arranged, edge upwards, in a box or drawer between strips of thick white blotting paper, they will be kept clean and the selection of any desired thickness will be greatly facilitated. The strips of blotting paper should be cut two thirds as wide as the cover, should reach from side to side of the drawer, and should be separated at the ends by squares of the same paper, thus forming a rack in which the covers can stand, edge upwards, and from which they can be readily picked out.

He recommends that one or two grooved blocks be kept on the working table, in which covers that have been selected for immediate use may be similarly supported on edge, and from which they can be easily taken by the forceps. Such a block is prepared by setting a circular saw so as to cut only 3/8th of an inch deep, and then passing over it several times a block of white wood, in such manner as to cut a series of parallel grooves on the side which is to be used as the top of the block. Standing covers in these grooves is a great improvement on the common method of leaning them against the base of the microscope or some other convenient but unsuitable object.

NEW MICROSCOPICAL JOURNALS.—The *Journal de Micrographie*, published monthly in Paris, under the very able editorial management of Dr. J. Pelletan, has already achieved, within a few months from the time of its first issue, a character of its own, not only as a successful business enterprise, but also as a powerful, independent and original scientific organ. It treats with equal ability and prominence both the theory and use of the microscope, and, in addition to original papers on the subject, gives a thorough and judicious summary of papers and progress in other countries. It is really occupying a field in which it has no competitor in any part of the world, and our only selfish regret about it is that there is not an edition in the English language which would render it useful to a larger number of readers in this country. It is published by G. Masson, 120 Boulevard St. Germain, Paris, France, at $6 a year.

Prof. Romyn Hitchcock proposes to begin the publication, about the first of November, of a new journal to be called *The American Quarterly Microscopical Journal.* It will be published at three dollars a year, and will give, in addition to illustrated original articles, a summary of the progress of the science, gathered from all available sources. The support of many prominent microscopists has been promised, and the good-will of all will be extended to the attempt to establish a journal of a class which has hardly attempted before to live in this country. The address of the *Journal* is P. O. box 2335, New York City.

NEW AMERICAN OBJECTIVES.—Mr. Frank Wilkins, who formerly worked for the Ross House, of London, but now is with Mr. John Roach, of San Francisco, is making objectives which the members of the San Francisco Society consider equal to a good grade of English lenses. Our Pacific friends are much pleased at this notable addition to their local resources.

MINERALS FOR THE MICROSCOPE.—Mr. Chas. H. Denison, 531 California street, San Francisco, is supplying by mail specimens suitable for the microscope, selected from the characteristic minerals of the Pacific coast. Of course the various forms and combinations of gold, silver and cinnabar are made prominent among the selections offered.

SCIENTIFIC NEWS.

— Under the title of Die Vereinigten Staaten von Nord Amerika, Erster Band. Physikalische Geographie und Natur character, Dr. F. Ratzel, of München, has written a voluminous octavo of 667 pages, illustrated with five colored maps. After discussing the geology and physical geography, the author describes in a general way our river-systems and lakes, with the climate, and under the caption of the vegetable world, the relations of the vegetation and climate to those of Europe and Asia, the distribution of our forests, prairies and plains or steppes; in two appendices the author enters into the vexed question of the origin of prairies, and other botanical subjects. The last chapter is devoted to the animals of the United States, giving a general view of the distribution of animal life, and a view of our characteristic mammals, birds, reptiles, amphibia and fishes, molluscs, insects and lower animals; and the work closes with a series of sketches of our forest scenery, the Hudson river, the scenery of New England, the Alleghenies, the pine barrens, the Floridian tropical scenery, Niagara Falls, and a glance at the Rocky Mountains and California.

— The first Annual Report of the U. S. Entomological Commission has recently made its appearance, and forms a volume of about 750 pages. The main report contains chapters on a variety of subjects, and is copiously illustrated with lithographic plates, three maps and woodcuts. Naturalists will perhaps be interested in the chapters on the distribution, metamorphosis and anatomy of the locust. The report is mainly practical in its scope, so as to be of immediate use to western farmers. A further appropriation was made at the last session of Congress for the completion of the work.

— In view of publishing a work on the Antiquity of Smoking and the Aboriginal Art of Pipe Making, Mr. E. A. Barber, West Chester, Pa., requests the co-operation of archæologists. Any notes, references, accurate sketches, with explanations, or other information bearing on the subject, will be thankfully received and fully credited. Drawings, cuts, or photographs of unique or odd pipes, snuff-boxes, etc., of aboriginal tribes, are more especially desired. The object of the work will be a more careful review of the history of smoking and its dissemination among different peoples, particularly among pre-historic nations.

— A finely illustrated work, entitled Iconographia Crinoideorum in statis Sueciæ Siluricis fossilium. Auctore N. P. Angelin. Opus postumum edendum curavit Regia Academia Scientiarum Suecica, Cum tabulis xxis, Holmiæ, 1878, will interest American students of Silurian Crinoids. There are thirty-four pages of text, and the twenty-nine folio plates are beautifully drawn.

There are a good many details given regarding the arrangement of the plates of the calyx, and a number of Cystideans are illustrated.

— Prof. Edward Forbes and his Country, is the title of an interesting sketch of this gifted naturalist, and of the Isle of Man, his birthplace, prepared by Robert Garner for the *Midland Naturalist*, the journal of the associated natural history, philosophical and archæological societies and field clubs of the midland counties of England. We have seen several numbers of this journal sent to Hayden's U. S. Geological Survey, and American naturalists would find it to be a readable, attractive periodical.

— The Chicago Academy of Sciences presents a good record of progress during the past year. The total number of specimens in the Museum is 30,049, the shells amounting to 15,000, and the insects to 6,000 specimens. The list of papers read numbers 21 titles. Explorations in Florida have been made by Messrs. Velie and Calkins. One hundred and ten foreign societies and thirty American ones send their publications.

— The appointment of Prof. Spencer F. Baird to the Secretaryship of the Smithsonian Institution, is in every way appropriate. Prof. Baird's familiarity with the workings of the Institution, together with his wide acquaintance with the sciences, and with the needs of scientific men, are guarantees that a continuation of its prosperous career awaits the Smithsonian.

— Entomological Contributions, No. iv., by Mr. J. A. Lintner, extracted from the thirtieth annual report of the New York State Museum of Natural History, for the year 1876, contains a variety of articles relating chiefly to the Lepidoptera; a few of them are of a practical, economic nature.

— Recent arrivals at the Philadelphia Zoölogical Garden: 1 raccoon (*Procyon lotor*); 7 hog-nosed snakes (*Heterodon platythinus*); 2 chain snakes (*Ophibolus doliatus triangulus*); 1 scarlet ringed snake (*Cemophora coccinea*); 1 milk snake (*Coluber obsoletus confinis*); 7 colubers (*Coluber vulpinus*); 2 black snakes (*Bascanion constrictor*); 3 water snakes (*Tropidonotus sipedon*); 1 copperbelly snake (*T. sipedon erythrogaster*); 4 garter snakes (*Eutænia sirtalis*); 2 garter snakes (*E. sirtalis parietalis*); 1 young snake (*Bascanion* [*?*]) from Indiana; 1 copperhead (*Ancistrodon contortrix*); 2 milk snakes (*C. obsoletus confinis*); 1 pine snake (*Pityophis melanoleucus*); 14 prairie dogs (*Cynomys ludovicianus*), born in the garden; 4 ruffed grouse (*Bonasa umbellus*), born in the garden; 1 spotted cavy (*Cœlogenys paca*); 1 mule deer (*Cervus macrotis*), born in the garden; 2 gray gophers (*Spermophilus franklinii*); 2 common marmosets (*Hassale jacchus*); 1 stoat (*Putorius erminea*); 1 fallow deer (*Dama vulgaris*), white var., born in the garden; 1 lizard (*Sceloporus*); 1

song thrush (*Turdus musicus*), England; 1 robin (*Turdus migratorius*); 1 gray fox (*Vulpus virginianus*); 2 prairie wolves (*Canis latrans*); 2 swift foxes (*Vulpes velox*); 1 spider monkey (*Ateles belzebuth*), Brazil; 1 coati (*Nasua narica*), red var., Brazil; 1 opossum and 11 young (*Didelphys virginiana*).

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PROCEEDINGS OF SCIENTIFIC SOCITIES.

Appalachian Mountain Club.—June 12.—The reports of the Councillors of Topography and Art presented their report. Mr. W. H. Pickering described some new points of interest near Campton, N. H.; Miss M. F. Whitman read a paper entitled "Moat Mt. Experiences."

June 22.—The Club made an excursion to Mt. Wachusett.

July 10.—The fifth field meeting was held at the Fabyan House, White Mountains, N. H. Mr. Samuel H. Scudder spoke of the insects of high altitude in North America. Prof. C. H. Hitchcock exhibited a model of the White mountains, and read an explanatory paper, including the results of recent explorations.

Entomological Club of the American Association for the Advancement of Science.—The annual meeting of the Club will be held at St. Louis, Mo., on Tuesday, August 20, 1878, at three o'clock, P. M. All entomologists who are interested are invited to assist, and will report at the headquarters of the Association at the Lindell Hotel, on the 19th or 20th, where they will be informed of the exact place of meeting. The meetings of the Association will begin on the morning of August 21. Prof. J. K. Rees, at St. Louis, will give information to members about car fares and accommodations. B. Pickman Mann, Secretary.

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SCIENTIFIC SERIALS.

The Palæontologist, Cincinnati, July 2, 1878; U. P. James.—We have received the first number of this publication, which appears in octavo size, and is very neatly printed. We are informed on the title page that it will be issued whenever there is sufficient material in a state of preparation to warrant it. Its object is stated to be to insure "early publication of scientific memoirs in geology and palæontology, in order to avoid the frequent delays when depending on the regular serials, journals and proceedings of societies." This number containing a paper by Mr. U. P. James, on extinct *Invertebrata* from the Lower Silurian formation, and includes descriptions of twenty-nine species.

We have to remark on the advent of this publication, that we always regret the appearance of a new scientific journal unless

it be well supported by the "sinews of war," or have a field not already occupied by an existing one. Nevertheless, the method which marks the primitive stage of scientific organization of allowing incompetent persons to have charge of the issue of scientific serials, must result in independent publications. So whatever the *raison d'etre* of the publication before us, it offers an example of the only way of escaping various abuses.

ZEITSCHRIFT FÜR WISSENSCHAFTLICHE ZOOLOGIE, Supplement May 28.—On the first embryological phases of Tendra zostericola, by W. Repiachoff. Contributions to a knowledge of Protozoa, by A. Schneider. On the form and signification of organic muscle-cells, by W. Flemming. Remarks on the anatomy of Limnadia hermanni, by F. Spangenberg. Studies on the history of the Polish Tur (Ur, Urus, Bos primigenius), by A. Wrzesniowski. On the unity of structure of the brain in the different orders of insects, by J. H. L. Flögel. *Archigetes sieboldi*, a sexually mature Cestode nurse, by R. Leuckart. The Epiphysis in the brain of Plagiostomes, by E. Ehlers.

ARCHIV FÜR NATURGESCHICHTE, Yahrgang 44, Heft. 3.—Herpetological studies, by J. von Bedriaga. Contribution to anatomy of the integument of mammals, by H. Ribbert. Attempt at a natural classification of the spiders, by G. Bertkau. Reflections on the theory by which season dimorphism in butterflies may be explained, by P. Kramer. Contribution to a knowledge of hermaphroditism and the spermatophores in the nephropneutic Gasthopods, by G. Pfeffer.

ANNALES DES SCIENCES NATURELLES, March 20—Observations on the structure of the eyes of crustacea and worms, by J. Chatin. Observations on the *Notommata Werneckii*, and its parasitism in the tubes of Vaucheriæ, by M. Balbiani.

JENAISCHE ZEITSCHRIFT FÜR NATURWISSENSCHAFT, March 15.—Individuality in animals, by E. Haeckel. The Leptomedusæ of Heligoland, by R. Böhm.

PSYCHE, Jan., Feb.—Recent Progress of Entomology in North America, by S. H. Scudder. Bibliographical Record.

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ERRATA.—Page 351, line 18, for *equalis* Stm. read *ochracea* Brandt. Page 353, line 24, for Sb read Stm. Page 209, line 10, for rarely *read* surely. Page 211, line 15 from bottom, for true lily read tree-lily.

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THE SENSORY ORGANS—SUGGESTIONS WITH A VIEW TO GENERALIZATION.[1]

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PERHAPS in the whole range of physiological and anatomical studies, no subject is invested with a deeper interest than that of the sensory organs. It is by means of them that we first become aware of our own existence; it is by means of them, in other words, that consciousness is first awakened in us, and it is through them that we subsequently continue our acquaintance with the outer world. It would be of great importance, were it possible, to arrive at some general conclusion regarding their morphology—some general view regarding the essential elements or the essential conditions of their structure. Judging from our knowledge at present it may seem that an attempt in this direction would be fruitless. Notwithstanding there are several prime facts which do not seem to have attracted the general attention which their importance deserves, and these when placed in their proper relations may give a new character to the subject, and perhaps open new avenues for investigation.

It will be interesting, therefore, to hastily review what is known regarding the *constant* elements of the various sensory organs. Under this head, of course, it will be unnecessary to consider the more or less mechanical arrangements by which force is conducted, and we will adhere, therefore, to that part of the literature only which treats of the ultimate structures by which impressions appear to be received.

[1] Read before the Alumni Society of the Auxiliary Department of the University of Pennsylvania, March 29, 1878.

It will be found most expedient to commence with the *organ of hearing*.

Here the percipient structure is either situated in, or constituted by, the epithelium of the maculæ acusticæ of the ampullæ and saccules, and by Corti's organ. Concerning *this* there can be no doubt, and were we to analyze the subject no farther, it would be sufficient for our purpose. The epithelium of the maculæ acusticæ, as we know, is made up of several kinds of cells. Prominent among these is one bearing a hair-like structure on its peripheral end, and possessed of central out-runners or processes. Now regarding the distribution of nerve-fibres to these acoustic spots we may hold the following views: either that the nerves end in plexuses and loops *in* or immediately *beneath* the epithelium, or that they are directly continuous with either the cylindrical, the stellate or the hair-bearing cells. Almost any one of these suppositions would suffice for the main points of the generalization I have in mind, but when we turn to the literature bearing immediately on this point, we learn that the constant or essential element of the maculæ acusticæ, and in fact of the organ of hearing, appears to be a cell bearing a central and a peripheral process. This cell is constant throughout vertebrates and, as far as known, throughout invertebrates. The entire literature makes it also more than probable that these cells are directly continuous with nerves. Thus, Max Schultze already in 1858 (Muller's Archiv), in speaking of the ultimate nerve termination in the ear of the petromyzon, ray, pike, etc., advanced strong grounds in support of this view. Deiters, in 1860 (M.A.), described the hair-cells of birds, and considered their connection with nerves probable, while in 1862 (*Ibid.*) he described the hair-cells of amphibians, and in the "lagena" believed them to be directly continuous with nerves. About this time, also, F. E. Schulze claimed to have seen the direct transition of nerve fibres into the auditory hairs of young sea gudgeons. In 1867, Hasse (Zeitsch. d. Wissensch. Zoölogie, Bd. xvii) described the hair-cells of birds, and said that he clearly made out the entrance of the nerve-fibres into them. He said that he frequently traced the central processes of the cells for long distances in the course of the nerve-fibres, and *vice versa*, he traced the nerve-fibres in the direction of the central processes. Odenius, 1867 (A. f. M. A.), advocates for man the same thing. He says, that all comparative

researches point to that conclusion; that the fibres of the auditory nerve do not end in loops, that they do not become continuous with the blunt-ended cylindrical nor the stellate cells. The only remaining element is, therefore, the hair-cell, and this in every way supports the view of its nervous connection. It not only becomes stained with osmic acid (Waldeyer, Stricker's Hdb.), similar to nerve fibres, but its central process presents the same appearance as the latter. In 1868, Hasse (Z. f. W. Z., Bd. xviii) investigated the ear of the frog, and strongly expressed the same view as maintained by the previously mentioned authorities; in fact, in one instance he believes to have really seen the nerve terminating in the hair-cell (stäbchenzelle), but does not lay too much stress upon it. Waldeyer, 1868 (Stricker's Hdb.), claims the nervous continuity of the inner hair-cells of Corti's organ as a positive fact. He says, "the inner radial (nerve) fibres pass, as I have often been able to prove, directly through the granular layer and terminate in the pointed ends of the inner hair-cells." Gottstein, 1872 (A. f. M. A.), like Waldeyer, says, that the inner radial nerve-fibres enter the inner row of hair-cells, while the outer are supplied by fibres stretching directly across the tunnel formed by Corti's arch. Ladowsky, 1876 (A. f. M. A.), expresses emphatically the same conclusions maintained by Gottstein. He asserts notwithstanding the purely negative results of Nuel (A. f. M. A. viii), the nervous connection of the hair-cells strenuously as follows: "I assert, along with Boetcher, that the connection between nerves and cells can nowhere be demonstrated so clearly as in the cochlea . . . . . Boetcher says, that he could, with some animals, as the hedgehog, find the connection of the nerves with the end-cells in almost every section."

The Organ of Smell.—This, when analyzed, appears likewise to consist of a cell with a central and a peripheral process. The outline of the literature is as follows:

In 1857, Ecker described the epithelium of the olfactory region (Z. f. W. Z. Bd. viii), but did not claim any nervous connection with cells. Later investigators, however, J. L. Clark and Max Schulze, strongly advocated the view of the direct nervous continuity of the so-called "olfactory" cells. Clark, 1862 (Z. f. W. Z. Bd. xi), traced the nerves into a fine sub-epithelial plexus, and thence believed them to become continuous with the central processes of these cells. Max Schultze, 1863, (Abh'dl'g. d.

Naturges. zü Halle, vii), described the olfactory cells of fishes, amphibians, birds and mammals, and strongly argued for their direct continuity with nerves. His theory rests on the complete chemical and morphological analogy between the central ends of the olfactory cells and the nerve fibrillæ. Prof. Babuchin, 1868 (Stricker's Histology), says that he possesses a chloride of gold preparation from a tortoise, in which can be observed the immediate passage of the nerve fibrillæ into the epithelial layer, "where they can be followed into the nuclei of the olfactory cells." He says, "this might raise M. Schultze's hypothesis to an actual fact if we possessed in the chloride of gold a substance which stained only nervous elements, and if this re-agent were not so very uncertain in its action." Von Brunn, 1875 (A. f. M. A. xii), describes, in addition to the epithelial and olfactory cells described by Clark and Schultze, a homogeneous membrane covering the olfactory region of mammals, and which is pierced by the peripheral processes of the olfactory cells. This arrangement would seem to exclude the epithelial cells from immediate contact with any substance inhaled into the nostril, and confine such contact entirely to the peripheral ends of the olfactory cells. This would go very far to establish the fact that the olfactory cell is the essential or percipient structure of the organ of smell. At any rate, it is a cell peculiar to the olfactory region, is *constant* throughout vertebrates, and like the corresponding structure in the organ of hearing, the weight of evidence is in favor of its direct nervous continuity.

The Organ of Taste.—Here we meet with a peculiar difficulty at the outset, and one to which the consideration of other organs is not subject. It is at first a matter of doubt as to what structure really constitutes the organ of taste. From the literature of the subject, however, I think it may be fairly attributed to the so-called taste-buds, as is almost unanimously done by the investigators of these organs. The taste-buds are distributed most thickly where the sense of taste is most acute, and less thickly on parts of the tongue where the sense of taste, *per se*, is less but where the *general* sensibility is greatest, as the tip and anterior part of the dorsum. What gives the most ground for doubt regarding their gustatory function, is that Verson has found them on the lower surface of the epiglottis and Krause on the dorsum of the same. The latter, however, does not consider this

an objection to their being concerned in the sense of taste, while C. Davis (1877 A. f. M. A.), who describes these organs as existing in the upper parts of the larynx, says that whatever we consider as their function we must regard them as terminal organs of the glossopharyngeal nerve. He says that Vingtschau and Hönigschmied have given experimental evidence that the buds at the dorsum of the tongue are terminal organs of the glossopharyngeal, though he neither says in what the experimental evidence consisted, nor gives any references where it might be found. Leaving you to form your own views, I will briefly pass over the pertinent literature of these organs. They have been found in fishes, amphibians and mammals. Waller appears to have been the first to investigate the epithelium of the fungiform papillæ of the frog, while Leydig first described the "taste-disks" of fishes, and was disposed to consider them as tactile organs (1851, Z. f. W. Z. Bd iii, also 1857, Lehrb. d. Hist.). Billroth, 1858 (M. A.), and Hoyer, 1859 (M. A.), both described the peculiar epithelium of the taste-papillæ of the frog, and while the former thought a connection between it and nerve-fibres probable, the latter described the nerves as terminating bluntly beneath it. Axel Key, however, 1861 (M. A.), described the same structure and pictured the nerve-fibres as directly entering certain cells, which are designated by the term "taste-cells." His results were attacked by Hartman, 1863 (M. A.), who, although he could assign no definite termination to the nerves himself, supposed them to end in plexuses beneath the cells. Beale, however, 1865 (Phil. Transactions), strongly supported Axel Key in the essential points. He showed that Hartman had destroyed the finer structures by his method of examination. Speaking of the nervous connection of these cells, he says: "In many specimens I have seen, and most distinctly the delicate network of fibres (in the body of the papilla) continuous with the fine nerve-fibres in the summit of the papilla, and I have demonstrated the continuity of these fine fibres with the matter of which the outer part of these peculiar cells consists. . . . . Upon the whole, I am justified in the inference that there is a structural continuity between the matter which intervenes between the masses of germinal matter at the summit of the papilla and the nerve-fibres in its axis, and I consider that an impression produced upon the surface of these peculiar cells may be conducted by *continuity of*

tissue to the bundle of nerve-fibres in the body of the papilla." In 1869 (Quart. Journal Micr. Science), Beale reiterated the same statement. In 1867, Engelman (A. f. M. A., iv) investigated the taste epithelium of the frog, and in the essential points of a cell with peripheral and central processes, and of the last being continuous with nerve-fibre, he agrees with Axel Key. Dr. Maddock, 1869 (Monthly Microscop. Journal), also investigated the same structure. He describes the taste-cells or rod-cells, as he calls them, and strongly supports the view of their direct nervous continuity. He says that the sensory nerves of taste do not terminate in free ends, "but in terminal organs consisting of nerve matter surrounding a germinal mass or nucleus; in fact," says he, "I regard them to the plexus of nerves beneath the papilla in the same relation as the retinal rods to the optic nerve."

In 1863 (Z. f. W. Z., Bd. xii), F. E. Schulze redescribed the taste disks of fishes and laid great stress on the fact that these structures are found in greatest number just where the glossopharyngeal nerve is most thickly distributed. They are found on the gums, the tongue rudiment, the inner side of the gill arches and the barbels, but also in lesser numbers on the lips and skin of the head and body. These last, as Schulze supposes, are probably for the purpose of perceiving at some distance substances dissolved in the water. He describes the taste-disk as consisting essentially of two kinds of cells, one being merely a supporting structure, and the other the percipient structure. The latter bears a central and peripheral process. In 1867, the same observer (A. f. M. A. iii, p. 152), states that the peripheral process bears a small hair as it does in mammals. In 1870 (A. f. M. A.), he also described the taste-discs of the tadpole, and remarked their close resemblance to those of fishes, which might almost have been predicted.

In 1868, Schwalbe (A. f. M. A. iv,) and Loven (Ibid.) described almost simultaneously and independently the taste-buds of mammals. Their descriptions agreed in all essential points; namely, in there being two kinds of cells, one having the value of a protective or supporting structure, and another which had a central and peripheral process and which was probably continuous with nerve-fibre, which in its chemical reaction it resembles (Engleman in Strickers' Hdb.). Subsequent investigators have merely corroborated the results of the preceding. Thus, von

Wysen, about 1870 (A. f. M. A. vi); von Ajtai in 1872 (A. f. M. A. vii); Hönigschmied in 1873 (Z. f. W. Z. xxii), who also noted the occurrence of taste-buds on the *free* or *upper* surface of circumvallate papillæ, though their presence here was not constant and they were generally smaller than those found on the sides. He says, also, that there can hardly be any doubt regarding the continuity of the taste-cells with nerves. In chloride of gold preparations from the cat he traced the nerves directly into the buds, and what is worthy of remark, the cover cells were *not* stained by chloride of gold, while the taste-cells *were*.

Before proceeding any farther, it will be necessary for the correct understanding of the view I wish to present, to consider some organs not possessed by man.

In fishes and amphibians we find a set of organs whose sensory character was first claimed by Leydig in 1850 (M. A). I refer to the so-called "mucous canals." In 1861, F. E. Schulze (*Ibid.*) re-described these organs as containing small cellular elevations, from which arise a number of stiff parallel hairs, which reminded both him and Leydig of the auditory hairs. A profile view of the typical structure, according to Schulze, reveals a hyaline cylinder generally much longer than the hairs, which it encloses and to which it allows free access of water. In speaking of the relation which the nerve fibres bear to the cellular elevations, he says: "In the lower layer I see round cells . . . . . These I take to be connective tissue cells. Between these last we see in fishes of a certain degree of development (15 mm. and over), sharply contoured nerve fibres which are given off from the nerves approaching the elevation. After they have passed between these cells they terminate by means of a "conical narrowing" in the above mentioned hairs. This is most readily seen by fixing the eye upon a single hair and then following the inward continuation of the same. In so doing we recognize as the base of the hair a conical body which protrudes over the epithelial surface. . . . This little ten-pin-shaped body (Kegel) we again recognize as the narrowing of a nerve fibre lying between the epithelial cells. . . . . ." In 1870 (A. f. M. A.), F. E. Schulze re-investigated these organs, and made some important additional statements. What he had previously described as a ten-pin-shaped narrowing of the nerve fibre into which the hair is inserted he now describes as a nucleated cell; *i. e.* he now describes as the ultimate sensory apparatus

in the mucous canals or side organs of fishes and amphibians certain nucleated cells bearing hairs and connected with nerve fibres. His conclusion regarding the function of these structures is as follows: That the side organs "represent a sensory apparatus especially adapted to presence in water, and for the purpose of appreciating mass movements of the surrounding medium against the body of the fish or of this against it, and also to perceive coarse waves which are promulgated by the water and which have longer periods of vibration than those appreciated by the organ of hearing."

Transitional forms between such of the side organs as have large, hyaline cylinders and which stand out directly from the body of the fish, and the completely covered mucous canal, are present. Some are described in which the cylinder is small, rudimentary or absolutely wanting. Others still which are situated in a groove or depression of the surrounding skin, and some in which the edges of the groove overlap and thus form the transition to the covered mucous canal. The significance of this is unmistakable. In 1868, Franz Boll (A. f. M. A. iv) investigated the mucous ampullæ of the snout of the shark and the *Torpedo marmorata*, and described and pictured as the essential and percipient structures of these organs cells with central and peripheral processes, and argued for the nervous continuity of the same. Langerhans, 1873 (A. f. M. A. ix), described the side organs (or organs of a sixth sense as Leydig calls them) of the larva of Salamandra maculosa. His results agree in every particular with those of F. E. Schülze. Malbranc, 1876 (Z. f. W. Z. xxvi), also supports the results of F. E. Schulze and Langerhans completely. Previously the side organs had been described only in *larval* amphibians, but Malbranc also found them in the adult forms of Proteus, Siredon, *Triton cristatus* and *taeniatus*.

That the essential or percipient structure of the side organs can be expressed in the same terms as the auditory, olfactory and taste-cells, seems indisputable, nor can we fail to appreciate the significance of this fact. Indeed, already in 1862 Max Schultze expressed views regarding the identity of the nerve terminations in the organs of hearing, smell and taste; and in speaking of the common sensation of fishes, he says (Sitzbericht d. Niedl'd. Ges. zu Bonn. 1862), "Here there are places in the skin where the nerve-cells not only protrude themselves into the epidermis, but

also carry hairs which extend beyond the epithelial surface, as in the ear. They serve probably as tactile organs of the most delicate character in order to take note of movements of the water which would not be appreciated by ordinary organs of touch."

In man the character of the medium in which he lives and the dryness of the epithelium, would seem to forbid such a structure, yet it becomes a very interesting question whether in mammals in which the necessary external conditions are present such a structure reappears. Indeed, our interest is perhaps augmented when we find that Camper, about 1822, discovered innumerable openings on the lower jaw of the whale, which were like the mucous canals of the pike. Concerning their structure and even their presence in other Cetaceans nothing is known.

There are certain great facts of embryology which might almost lead us to suspect from an "*a priori*" point of view some bond of union between sensory organs. In the first place, the nerve epithelium of the ear, the olfactory region and the taste-buds, are developed from one and the same layer, namely, the epiblast of the embryo. Again this layer is the same as that from which the central nervous system is developed, and this fact alone would naturally lead us to look for the ultimate sensory apparatus in the *epithelium*. These organs being developed in the same layer, we might expect to find some morphological connection or relation between them. The ear, as we know, is formed by an inflexion of the epiblast, while the nasal and oral cavities are lined by the same layer. Therefore, if, as we have seen, there are sensory cells in the epithelium covering the body, the cavities formed by the inflexion of this epithelium would contain these sensory cells.

For the ear, even additional evidence is furnished by the Savian vesicles of the torpedo. These are closed fibrous capsules, containing an interior granular substance, and supplied by a nerve twig. They are arranged in linear series bordering the anterior part of the mouth and nostrils, and extending over the surface of the fore part of the electrical organs (Owen, Comp. Anat.; and Boll M. A. 1875). Max Schultze was the first to investigate the histology of these organs. He tells us that they contain an epithelium bearing stiff, non-vibratile hairs, and he expresses the opinion that the nerves bear the same relation to it as in the ear, nasal m. m. etc. Boll (M. A. 1875) re-investigated the Savian vesicles and

described them more minutely. He corroborated the general statements of Max Schultze with regard to the hair-bearing epithelium, stating that the hairs are so very perishable that they can only be observed in fresh preparations. He finds on the floor of the vesicle three small eminences lying in the direction of the fibrous attachment, the middle one being the larger. These are constituted by cylindrical epithelial cells and the perceptive cells, while the rest of the vesicle is lined by a flat epithelium. The nerves are distributed *exclusively* to the *eminences*, and are, as Boll thinks, probably continuous with the perceptive cells. These bear peripheral and central processes.

Regarding these organs Max Schultze (Abh'dl'g. d. N. ges. zu Halle. 1863) makes the following interesting remarks: "As they are closed vesicles and lie somewhat deeply hidden, we can look upon them as the transitional forms between feel-hairs ending freely in the water and which are possessed by fishes and naked amphibians, and the nerve-hairs of the ampullæ of the organ of hearing. In this last, the arrangement of the nerve-endings for the perception of sound waves from the endolymph, is evidently so similar to the structure in the Savian vesicle, that the question might arise whether the latter belongs to the sound perceiving organs. As the electric ray possesses very well-developed organs of hearing in the shape of otolith saccules and semicircular canals, there are no grounds for ascribing yet another organ of hearing to it. Therefore we adhere to the supposition that the Savian vesicles are a special modification of the organs of common sensation. . . ." Further on, he says that they probably appreciate coarse waves or vibrations in the water.

A very significant fact, and which probably brings the side organs or mucous canals, the Savian vesicles and organ of hearing into the same category, is the following: The Savian vesicles are supplied by the *fifth* pair of nerves, while the mucous canals or side organs are supplied by the lateral nerves, which again are *made up largely of the fifth*, in some fishes almost entirely; and a most remarkable fact, but one which is entirely explainable by embryological data, is, that in one fish, the skate (Owen, Comp. Anat.), the auditory nerve is apparently a *primary branch of the fifth !*

Now, while bearing the facts with regard to the sensory organs in the epithelium of fishes and amphibians in mind, let us see

what is known regarding sensory structures in the epithelium of mammals. At once the well-known results of Connheim (Virchow's Archiv xxxviii, 1867) and Hoyer (M. A. 1866, also A. f. M. A. ix 1873) with regard to the nerves of the cornea occur to us, which prove that the nerves really enter the epithelium. Besides this, Langerhans (Virchow's Arch. xliv, 1868), demonstrated in man the entrance of nerves into the epithelium covering the body. He describes the nerves as entering the rete mucosum and then passing upward between the epithelial cells. He describes also peculiar stellate bodies which he thinks are very probably continuous with the nerves, on account of their chemical reaction. Podocopaew (A. f. M. A. v. 1869) confirms the results of Langerhans for the rabbit in all essential points. Eberth (A. f. M. A. 1870) likewise supports the investigations of Langerhans in the important particulars, and believes that no terminal network exists, but that the nerves end free in the epithelium. Chrschtschonowic (Sitzbericht. d. Wiener Acad., Feb., 1871) says that the nerves enter the vaginal epithelium and there form plexuses. Elin (A. f. M. A. vii, 1871) says that the nerves enter the epithelium of the mucous membrane of the mouth and join cells "in the upper part of the rete mucosum" fibres, also passing to the upper part of the epithelium. Eimer (A. f. M. A. viii, 1872) described the nerves as entering the epithelium of the teat of the cow, and believes them to be continuous with the "Langerhansian bodies." Perhaps more interesting than all, however, are the results of Eimer (*Ibid.* vii, 1871) with regard to the snout of the mole. This investigator describes the nerves as entering the epithelium covering the snout and passing upwards. The epithelial cells immediately above the entrance of the nerves are arranged in a circular manner, so as to present somewhat the form of a cylinder, thus producing a *specialized* structure. Eimer tells us that whenever a nerve-fibre passes one of these cells, it presents a bulbous enlargement or swelling, and finally terminates by such a swelling in one of the cells.

Now, whether the nerves end free, end in plexuses, in the Langerhansian bodies or the cells of Eimer, of one thing we are certain, and that is that the ultimate sensory structure is *in the epithelium*, a conclusion which, it is needless to say might have been predicted on "*a priori*" ground.

I think it well now to present the interesting results of Meckel

(A. f. M. A. xii), as at least a possible, if not a probable method, of explaining the touch-bodies; *i. e.*, the corpuscles of Krause, of Meisner and Wagner and the Pacinian bodies. Koelliker tells us that they are all probably modifications of one and the same thing, as intermediate forms exist all over the body. Now Meckel describes cells as existing in birds and mammals into which he directly traces nerve-fibres. He designates them as "touch-cells" and describes their transition into touch bodies. The touch-cells are situated ordinarily *beneath* the epithelium, but in the bill of the pigeon they present every transitional stage between cells entirely buried in the sub-epithelial tissue, cells partially extending into the epithelium, and cells entirely enclosed by the epithelium. Again, in the snout of the hog the "touch-cells" are *all* in the epithelium, though in its lowest layers. They are larger than nerve-cells generally, and frequently two or more become joined so as to form twin cells or a more complex arrangement. These last are found *beneath* the epithelium. Then he also describes structures made up of a larger number of cells, but in which the nerve-fibre still supplies each individual cell. Then he describes others which are still more complex and in which the separation into cellular elements is still less apparent. All the complex forms are *beneath* the epithelium, only the single cell is found in the latter.

If the results of Meckel are *correct*, we have a link between the sensory structures of the epithelium and the touch-bodies, and the latter might be looked upon as epithelial structures in reality, but which have become displaced in the progress of development. The legitimacy of such an inference, however, would be rendered highly doubtful by the existence of the Pacinian corpuscle in the mesentery of the cat. To these last structures Arndt (Virch. A. lxv, 1875) ascribes a very peculiar significance, but which is hardly satisfactory. From observations on fœtal cats he comes to the conclusion that the Pacinian corpuscle is an outgrowth of the vascular system of the mesentery.

Let us now turn our attention to a field that has been thus far neglected; namely, the *organ of sight*. The retina, though not developed from the epithelial layer of the embryo, is yet produced by an outward growth of another portion of the same layer. To this, however, I think we should not attach too much importance.

In all the retinæ of vertebrates two elements among others appear to be constant, namely, the layer of rods and cones and one corresponding to the layer of external granules. Each rod and each cone is thus connected with a cell element, and certainly it requires no great stretch of the imagination to see here a structure corresponding to a hair-cell. We have a cell with a central and peripheral process which last bears an apparatus to receive the immediate impression of force. Besides evidence by no means ends here. In those invertebrates whose eyes approach and even exceed in their complexity those of vertebrates, as the gastropods and cephalopods, the same elements remain constant, namely, the rods with their cells (Schultze, A. f. M. A. v, 1869), (Babuchin, Würzburg Verh'dlg, 1865) (Hensen Z. f. W. Z. xv, 1865).

We must remember also that in the eyes of molluscs the relation of the rods to the eye is exactly the reverse of that in vertebrates; namely, they point directly forwards and constitute the *innermost* layer of the retina, while in vertebrates they point directly backwards and constitute the *outermost* layer. This fact assumes great significance when we learn what is known concerning the development of the eyes of molluscs. Hensen says (Z. f. W. Z. xv., 1865), that the eyes of cephalopods probably originate in the same manner as the ear and nose of vertebrates, *i. e.*, by an inflexion of the epithelial layer. In the nautilus, he says, it is evidently the case, while for the gastropods this has *actually been observed* in a pulmonate snail of the Phillipines, by C. Semper[1] (quoted by Hensen).

When we are told by Boll (A. f. M. A. v, 1869, supplement), that the epithelium of molluscs everywhere contains hair-cells continuous with nerves, it would seem to place the morphological value of the rods and cells in these animals beyond a doubt. Boll describes what he calls the "neuro-epithelium." He pictures *stiff, non-vibratile* hairs, distinct from vibrating ciliæ, and surmounting elongated nucleated cells. They occur all over the surface of gastropods and cephalopods, being more thickly situated in parts used for apprehension or contact, as the arms of the cuttle-fish and the edges of the foot of the snail. Flemming (Ibid. v, 1869 and vi, 1870) corroborates Boll's statements in the main points, though he differs from him in the detailed description of the hairs.

[1] Semper has written a separate paper on molluscan eyes, which I could not obtain.

Boll also, although he determined the direct nervous continuity of the hair-cells in the ears of these animals, did not establish the nervous connection of the hair-cells in the epithelium. Flemming described long central outrunners, which can be drawn out from the sub-epithelial tissue to a comparatively great length, and which become more or less varicose in preparations treated with potassium bichromate and osmic acid. He also describes the sensory cells of pulmonate snails, but in these the hairs do not reach above the surface of the epithelium, apparently a modification to suit external conditions.

Judging from the above, we have, to say the least, good grounds for including the percipient structure of the organ of sight in the same generalization as that of the other sensory organs. As regards the other layers of the retina, may they not be simply of ganglionic value? The comparative simplicity of the retina of molluscs seems, in cephalopods, to be counterbalanced by the existence of a ganglion just before the optic nerve enters the eye. Again, the ganglionic character of the olfactory lobes may be of equal value. Indeed, this comparison might assume importance when we remember that both the olfactory lobe and the retina are processes of the cranial vesicles.

Conclusion.—In casting a last glance at the sensory organs they seem to arrange themselves more or less readily into groups. Thus, the side organs or mucous canals, the Savian vesicles and the organ of hearing, seem to constitute a sub-division by themselves. The organs of taste and smell seem to constitute another, while the eye seems to occupy a third sub-division alone. With regard to other sensory structures it would be hazardous to make any suggestions.

On the ground of certain principles that I have expressed, and of others even far more general, we may be led to suspect from the very beginning the common genesis of sensory organs; and it was a sincere conviction in the truth of such principles that led me to read the literature bearing immediately upon the subject, and to learn in how far such an opinion is supported by fact. How much it is supported by the results of the investigators which I have adduced, and the possible relations I have pointed out, I will leave you to judge.

[NOTE.—The literature referred to in this paper is that only which pertains directly to the questions in point. One or two papers I

have been unable to obtain and have quoted them from others. I have knowingly omitted none that seemed important or the results of which seemed to contradict the general views suggested by the writer, with perhaps the single exception of the paper of C. B. Reichert (A. f. A. and Ph., 1871), who thinks that the early differentiation, in the embryo, of the epithelial layer and the central nervous system destroys all probability of the nerve endings being in the epithelium. How much his opinion is supported by fact, the more recent literature as adduced will enable you to judge. He rejects, in consequence, altogether the nerve-termination in the organ of hearing, as held by most observers, and even denies that the nerves pass through the openings in the zona perforata! a fact which every investigator with whom I am familiar admits and which I have myself witnessed. Reichert is the only one to my knowledge who so radically denies the results of the other investigators. To me the general agreement among so many observers, in such varied fields of research, seems to point unmistakably to some *one underlying truth*.]

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PLANTS USED BY THE INDIANS OF THE UNITED STATES.

BY DR. EDWARD PALMER.[1]

The first paper upon this subject by the writer was published in the Report of the Department of Agriculture for 1870. The present paper will embrace all the additional matter that has since come under his observation.

Fruits and Nuts.—*Juniperus pachyphlæa* Torr., one of the finest ornamental Junipers, its wood being excellent for cabinet work; height about forty feet, and diameter from two to three feet. Abundant in Arizona. Its fruit, a staple article of food among the Indians, is sweet, having but little of the juniper taste. As soon as ripe the Indians commence to eat the nuts raw, and to lay up great quantities for winter use. They are then ground fine and made into bread.

J. Californica, a dwarf but showy evergreen. Southern Californian Indians consume immense quantities of the fruit

[1] The writer wishes to acknowledge his obligations to Prof. Asa Gray; Mr. Sereno Watson, of Cambridge, Mass.; Dr. C. C. Parry, Davenport, Iowa, and Dr. George Vasey, Department of Agriculture, for kindly determining the species.

which is sweet and is eaten as soon as ripe. When the fruit is dry it is either ground fine and made into bread, or boiled in water to the consistency of mush. It must be nutritious, as the Indians get fat on it.

J. Californica var. *Utahensis* attains a height of twenty or twenty-five feet in Utah, and a diameter of twelve inches. The Utes eat the fruit raw or made into bread. As in the former species, the taste is quite sweet. These Indians use what they call Noo-ahn-tup, or what appeared to be excrements of insects left in hollows of the junipers, said to be ground and used for mush by the Pah-Ute Indians. The fibrous bark of this tree is made into saddles, breech clouts, skirts, and mats to sleep on. The bark is rather brittle and not so good for domestic purposes as that of *Cowania mexicana*.

J. occidentalis.—The berries of this tree are gathered and consumed for food but have more of a juniper taste than the former species.

Pinus torreyana, a very rare pine, on hills of Solidad, Southern California, only. The nuts are large and wholesome. Only the Indians near by gather them, as they are not in great abundance.

P. monophylla.—The common pine on the border of Lower California. It is a very productive tree. Its seeds, though rich, and good when fresh, are more digestible after being roasted, besides in that condition they will keep fresh a long time. Heat dissipates the oil property of the kernel and renders the hull brittle and easily removed. It is astonishing how many of these nuts an Indian can eat. From morning until night, as long as they last, cracking and eating go on. The Indians get very fat during a good pine nut harvest. They remove the hulls by putting a number of the nuts on a metate, and by rolling a flat pestle backward and forward until the hulls are loosened. The mass is then put into a flat basket tray and the hulls are blown off. The kernels are now ready to be eaten, or ground on the metate to flour, which if made into bread or mush is a palatable and nutritious dish. The interior of the young cone is also eaten.

As soon as the pine cones begin to open the Indians assemble for their great feast and camp among the pine trees during the nut harvest. The fruit upon the ground is gathered up by the children, while the females pluck from the trees the unopened fruit,

which they place in a net. Draw strings are tied around the neck of the net which, when full, is let down by means of a long rope fastened to the centre of the draw-string. Some one on the ground empties the load, and the net is drawn up to be refilled. Thus for many days this gathering goes on until the supply is exhausted, or they have satisfied their wants. To hasten the opening of the cones, they are thrown on hot ashes for a few minutes. The seeds are at once removed and put into an earthen pot over a slow fire. After a few stirrings they are sufficiently parched to render the hull brittle, so as to be easily removed, while the oil in the kernel is set free. By this process the kernel is rendered more digestible and will keep for a long time. If not parched, the seeds would soon become rancid and mouldy.

Algarobia glandulosa or *Prosopis juliflora*, in Texas, Arizona, New Mexico, and Sonora, grows from twenty to forty feet high, and eighteen inches in diameter. Charcoal is manufactured from it, and it is also made into handsome furniture, the grain being very fine. It flourishes where no other fruit tree would grow, and is one of the most useful trees of the deserts. It yields a gum nearly indentical with gum arabic for medicinal and technical purposes, especially in the preparation of mucilage, gum drops, jujube-paste, &c. In parts of Texas great quantities are gathered for exportation. The Indians have long been acquainted with its valuable properties, for they not only eat it but mix it with mud and cover their heads with it for two or three days. When washed off, the hair of the oldest is not only jet black, but the unwelcome visitors that previously lodged therein are all dead. The leaves of this plant are used by the Indians of Southern California to give the blue color to their freshly tattooed faces, the spines of a species of cactus being used to puncture the skin. The moistened leaves are then rubbed over the markings and the desired color is obtained.

The fruit of this plant is one of the leading articles of diet with the Utah, New Mexico, California and Arizona Indians. It is gathered and housed with great care. Last winter I watched the process of converting the seed-pods of this plant into bread. A female squatted herself on the ground by a wooden mortar, the lower end of which was some distance in the ground. With a long stone pestle she pounded the hard seed-pods into meal. She then took from her head a small conical hat, and sprinkled a

little water on the inside, then a little meal alternately, until the hat or bread tray was filled. After being patted on the top, it was set on the ground and exposed to the direct rays of the sun for some hours, or until it would turn out a solid cake or bread. So little water had been used to wet the meal that it seemed to me it would not stick together, but possessing a large percentage of sugar, little water was necessary. This was rather chaffy-looking bread, not unlike that made of corn meal with all the bran in it; nevertheless, it was very sweet. The Indians keep fat as long as this bread lasts.

Quercus emoryi, a rather common tree in Arizona, but the wood is of no use except for fuel. This tree as well as other varieties in the same region, however, yields abundance of food.

In the Smithsonian collection at the Centennial Exhibition was a sample of sugar from the mountain oak, at McCloud river, sent by L. Stone. The sugar or manna-like substance was in small irregular lumps of a dull color, and very brittle.

Q. undulata var. *pungens*.—This is a dwarf, compact bush, and very prolific. Its fruit is as sweet and as pleasant as fresh chestnuts, and is considered a great delicacy by the Lower California Indians. So ripe are the nuts before they fall, that nearly every one germinates while still in the cup.

Q. chrysolepis, the finest of Southern California evergreen oaks, produces the largest acorn and cup, but, though much used as food, the nuts are not considered as good as some others.

Q. sonomensis; a common deciduous oak of the hills about Julian, Southern California, very productive, affording much choice Indian food.

Q. agrifolia; this beautiful evergreen oak is very abundant in Southern California. When deprived of its branches, it will sprout again as freely as a willow. Its fruit is considered by Indians superior to all other acorns. The failure of the acorn crop is a serious loss, and drives the Indians of Southern California to hunt up every kind of substitute for them. In preparing food from acorns, the first thing is to take off the hulls. This is done in a mortar by a few slight strokes. The hulls are then removed, and the kernels reduced to a very fine meal. As all acorns, with few exceptions, possess a bitter, astringent property, which renders them unfit for food until it is removed, the Indians accomplish this by laying a coarse flat basket or strainer on a pile of gravel

with a drain underneath. Rather fine gravel is now scattered thickly over the bottom, and up the sides of the strainer, and the meal laid thickly over this gravel. Water is added, little by little, to set free the injurious matter. When the water ceases to have a yellowish tinge, the deleterious property has been separated. The meal is removed by the hand as much as possible, after which water is poured over the remainder, so as to get the meal together. It is then scooped up by the fingers, very little being wasted in the operation. The meal is cooked in two ways: First, by boiling it in water, as we do cornmeal mush. When cooked by this process, it is not unlike yellow cornmeal mush in appearance and taste. The second mode is to take the meal, as soon as it is washed, and make it into small balls which are wrapped in green corn leaves. These balls are then placed in hot ashes, some green leaves of corn are laid over them, and hot ashes, placed on the top of sufficient thickness to bake the cakes. These are considered extra nice by Indians. Females not only gather and store the acorns, but perform all the work necessary to convert them into food.

Rhus aromatica var. *triloba* (Squaw berry), so named because the Indian women gather large quantities of the berries which are used as food. They are of a red color, and excessively sour, but very much used while fresh, during the summer months. The berries when macerated makes a very pleasant drink, and they are also dried for food. The young twigs of this plant are used in the manufacture of baskets. The wood exhales a peculiar odor, which is always recognizable about Indian camps, and never leaves articles made from it. It grows loosely in mountain ravines, and attains a height of five to eight feet.

In Utah, Arizona, Southern California, and New Mexico, the Indians depend solely upon this plant for material out of which to make their baskets. It is far more durable and tougher than the willow, which is not used by these Indians. The mode of preparation is as follows: The twigs are soaked in water to soften them, and to loosen the bark, which is scraped off by the females. The twigs are then split, by the use of the mouth and both hands. Their baskets are built up by a succession of small rolls of grass stems over which these twigs are firmly and closely bound. A bone awl is used to make the holes under the rims of grass for the split twigs. Baskets thus made are very durable,

will hold water, and are often used to cook in, hot stones being dropped in from time to time until the food is done.

Cerasus ilicifolia.—Indians eat this fruit and save the seeds which they consume raw, or ground and cooked into mush. They are dried whole or split. This is a very common plant in California, and is very productive. Its fruit is of a yellow color, with a pink tinge, and has the shape of gage plums, but possesses little pulp. The seeds are large, affording much food.

C. demissa.—The wild cherry of Southern California, a dwarf bush, but very productive. Its fruit is palatable, either fresh or dry, and in both conditions it is largely consumed by the Indians.

Sambucus glauca (White elderberry); *S. racemosa* (Red elderberry).—The fruit of both these species is eaten by Indians. In Southern California the red species is preferred, being more fleshy and juicy than the white.

Mesembryanthemum acinaciforme (called strawberry). Its fruit resembles the strawberry in taste. This is one of the common plants along the sea-coast of Southern California, growing on sand beaches. It is very productive, and is eaten not only by Indians, but by Mexicans and other Whites.

Lycium pallidum, with scarlet fruit; *L. berlandieri*, Arizona, with fruit of a red color.

L. andersoni.—Fruit bright red, or amber color; Central Arizona and South-eastern California. The berries of these *Lyciums* are eaten by Indians of Arizona and California; in fact, Whites relish them also. They are quite agreeable to the palate, being of a sweet, mucilaginous substance, and adapted to warm climates. The clear bright-colored berry has a very tempting look, and when dried, resembles in taste dried currants.

Brahea armata.—This fine palm, found at the bottom of the Big cañon of the Tantillas, Lower California, grows from fifty to sixty feet high, its long, graceful, pendant branches of fruit making it a beautiful object. The Cocopah Indians consume large quantities of this fruit while fresh, and dry it for winter use; they also eat the base of the young leaves.

Pritchardia filamentosa.—This tree, from forty to fifty feet in height, is not so beautiful as *Brahea armata*, but its fruit is better food, containing more pulp, being much larger and of a more agreeable taste. Cocopah Indians consume the fruit fresh and dry in great quantities; the leaves could be applied to many use-

ful purposes. In the spring the base of young leaves is eaten raw by the Indians. The seeds of both these species of palms are ground fine and eaten, and are not inferior to cocoa-nut.

Shepherdia argentea (Buffalo berry), grows by water courses in mountainous districts of Central Utah. The habits of the tree are similar to those of the elderberry. It grows from ten to fifteen feet high, bears abundantly, fruit red, small, roundish, sour, but has a pleasant taste.

Amelanchier alnifolia (Service berry).—The fruit of this bush is much esteemed by both Indians and Whites.

Rhus integrifolia, produces abundance of red berries that are very acid. Indians of Southern California place them in water to form a cool acid drink.

Ribes menziesii.—Fruit very thorny, but Indians scald them to make them eatable.

Simmondsia californica.—The nuts of this plant yield a very fine oil. Indians of Southern California use them as an article of food

Arctostaphylos tomentosa, Manzanita of the Spanish.—The fruit is produced in clusters, and resembles a small apple. It is of an agreeable acid sweet, and is consumed largely by Indians and Mexicans, both in the ripe and dry state. Indians dry the berries in great quantities, and prepare a favorite drink from them. A quantity of the dried fruit is slightly pounded until the pulp is separated from the seeds and outer rinds, the flour or finely pounded pulp is separated and mixed with water which is allowed to stand until fermentation takes place, when it becomes intoxicating. This fruit, flour or dust is also eaten dry. The seeds after being deprived of their covering are ground fine and made into mush. A favorite mode of using the dried fruit is to grind it up fine and after mixing the flour with water, to form the mass into thin flat cakes which are baked in hot ashes. This bread is sweet and not disagreeable to the taste, though it has a repulsive, clay-like appearance of a reddish-brown color. All the western Indians relish this fruit in whatever way it is prepared. The Pah-Ute Indians use the leaves as tobacco and for medicine.

Photinia arbutifolia.—A beautiful tree whose berries are eaten by Indians of California, being first parched and ground, and then made into mush.

Vitis arizonica, V. californica.—Indians of California, Arizona and

Southern Utah consume large quantities of both species of grapes in the ripe state. They dry them also for winter use. The seeds of the ripe fruit are saved and ground fine and eaten in that condition; they sometimes also grind up the dried grapes and cook them. The Pah-Utes at St. Thomas, Nevada, had several sacks of dried grapes for sale last spring.

Comandra pallida.—This plant yields a small nut which is eaten raw by the Pah-Utes and the white children of Utah. If eaten too freely it produces nausea.

Roots and Tubers.—*Apios tuberosa*, common throughout the Northern and Southern States. It is known under the name of *Saa-ga-ban* by the Micmacs, by whom the pear-shaped roots are used as an article of food. The tubers are about the size of cherries, resembling common potatoes in taste, shape and odor. The skin is of a rusty or blackish-brown color. They contain a large per cent. of starch, which resembles that of wheat, and are very wholesome.

Zamia integrifolia (coontie root).—From the tubers of this plant the Florida arrow-root is made. It is abundant in the southern part of the State. The tubers are large, frequently a foot long and three inches in diameter, rough and dark on the outside, but white inside and yield a large per centage of starch. It possesses an acid, poisonous ingredient which has to be washed out in the process of converting the root into starch. The Indians of the Everglades consume a great deal of starch as food, prepared by their rude processes, and also sell some, but it is inferior to that prepared by Americans with improved machinery.

Hesperocallis undulata, (White lily).—The bulbs of this beautiful plant are used as food by the Indians of Arizona.

Sagittaria simplex.—The Mojave Indians of the Colorado river, Arizona, as soon as the water subsides in the spring, dig the bulbs of this plant, which resembles the crocus root. It is exceedingly farinaceous and palatable, whether raw or cooked with other substances.

Cnicus occidentalis?—The roots, which are about the size of carrots, are sweet and well flavored, but require a long preparation to fit them for use. A favorite food of the Pacific coast Indians.

Carum gairdneri.—The tuberous roots of this plant are much eaten by the Indians of the Pacific coast, either raw or boiled

with other substances. When raw it has a nutty taste but when cooked assumes a carroty flavor. Its outer surface is grayish, but its interior is white and farinaceous.

Milla capitata var. *pauciflora*, commonly called by the Mexicans of Sonora and Arizona, Corvena. It is rather a small bulb, resembling the crocus both externally and internally. Its taste is agreeable, sweet and mucilaginous, and is considered very nutritious, even by Americans.

Amoreuxia schiedeana; Himajins of the Papajos; *Saya* of the Pimos. It furnishes to the Indians of Arizona just named, an edible root. They eat it roasted or baked in hot ashes. It is quite palatable, with a slightly bitter tang.

Camassia esculenta.—Wild hyacinth, a very common plant in the upper Mississippi valley. Indians and Whites eat this root and find it very nutritious, with an agreeable, mucilaginous taste.

Valeriana edulis.—The root of this plant is eaten raw or dried; it is also ground into flour and made into bread or mush by the Pah-Ute Indians.

Claytonia lanceolata.—The roots of this plant, though small, are prized by the Pah-Utes as food, having a pleasant, crisp and nutty taste.

Psoralea castorea Watson, new species.—This plant grows in exposed sandy localities between Beaver Dams, Arizona, and St. Thomas, Nevada. The tuberous roots are large, very white, and farinaceous. The Pah-Utes eat them raw, or cooked in hot ashes, or ground up and made into bread or mush.

Psoralea mephitica Watson, new species.—The leaves of this plant yield a very disagreeable smell, but the tuberous roots, though small, are farinaceous and are consumed as food after being prepared as mentioned for *Psoralea castorea.* It is abundant on the low places between the hills south-east from St. George, Southern Utah, and the Pah-Utes resort there to collect its roots.

Roots of carrots, potatoes, beets, turnips and parsnips are eaten by Pah-Utes. These Indians have acquired the taste for the tubers of all these plants and they consume them in great numbers, either raw or cooked, without being cleaned. They place them in the hot ashes and devour them when cooked, skins, dirt and all. When boiled, not only are the tubers eaten but the water in which they were boiled is drank.

Seeds.—Corn, Native Indian; *Ah-weaph* of the Pah-Utes. This

variety has been grown by the Indians since the recollection of the oldest person among them. Well preserved kernels and cobs are found in the mounds of Utah. This species of corn grows from two and a half to three feet high and is cultivated by the Indians on the river bottoms, maturing in sixty or seventy days. The ears come out of the stalk five or six inches from the ground. Corn is a staple article of food with these Indians. In 1873 a Pah-Ute Chief, Tutzegavet, brought some very fine corn of his own raising to the agricultural fair, held at St. George, Southern Utah, and the first premium for that product was awarded to him.

Helianthus petiolaris, *H. lenticularis*, native sunflowers, *Awk* of the Pah-Utes. The seeds of these plants form one of the staple articles of food for many Indians, and they gather them in great quantities. The agreeable oily nature of the seeds render them very palatable. When parched and ground they are highly prized and are eaten on hunting excursions. The meal or flour is also made into thin cakes and baked in hot ashes. These cakes are of a gray color, rather coarse looking, but palatable and very nutritious. Having eaten of the bread made from sunflowers I must say that it is as good as much of the corn bread eaten by Whites.

Mokeack Sunflower.—A Pah-Ute chief obtained some seed of the large, cultivated sunflower and planted them, raising a large crop. Now many of the Indians plant this sunflower, and it goes under the name of the Chief Mokeack.

The native sunflower of Utah yields an exudation from the stems of creamy white color, nearly tasteless, but of a gummy nature. It is eaten by the Indians and white children of Utah, or rather chewed in place of pine gum.

Portulaca oleracea.—The seeds of this plant after being reduced to flour are eaten in the form of mush. The plant when tender is cooked as greens by the Pah-Ute Indians.

Sporobolus cryptandrus, or Quaque of the Pah-Utes, a species of grass, the seeds of which are much used by the Indians as an article of food. After being parched they are ground and mixed with water or milk and made into mush or biscuits. The flavor is good, and food thus prepared is very nutritious. The leaves yield a short, fine fibre, adapted to the manufacture of paper. It is abundant about St. George, Southern Utah.

Sporobolus airoides, *Eragrostis purshii*, *Panicum crusgalli* and

Vilfa asperifolia are very abundant grasses in Southern Utah, and their seeds are gathered in great quantities for food by the Indians, who first parch, and then grind them to flour, which is eaten either dry or in the form of bread or mush. It is healthful, nutritious and more agreeable in flavor than buckwheat.

Atriplex californica.—This plant grows in ravines and has large, long roots which are much used by Indians and Mexicans of California as a substitute for soap. After being pounded and mixed with water, it is said to be especially good in cleaning woolen fabrics. The seeds of this plant are also gathered, parched, reduced to flour, and made into mush or bread. At other times the seeds are ground without parching and used as if parched.

A. powellii, A. lentiformis, A. expansa, A. confertifolia, A. nuttallii, A. canescens.—All these yield abundance of seeds, which are gathered by the Indians of Utah, Arizona, and California. The seeds are ground into flour and made into bread or mush.

Sarcobatus vermiculatus, "Grease wood" of the plains.—It produces abundance of seeds, which are prepared for food in the same manner as those of *Atriplex*, and eaten by the western Indians.

Audibertia polystachya, white sage of California, is a very common plant in many parts of the State. From its flowers the bees make the celebrated honey for which San Diego is famous. Indians gather the seeds and use them cooked with other substances to impart flavor, as we do parsley.

Halostachys occidentalis, called *Tub-bo-welts* by the Pah-Utes.—The seeds are ground fine and made into bread or mush. It is one of the regular articles of diet.

Amarantus leucocarpus, A. powellii, Camoot of the Pah-Utes.—The seeds of both these species are highly prized as food products. They are regularly cultivated by the Pah-Utes and are also found abundant in the wild state on river bottoms. The plants are very prolific in seeds, which are very nutritious and of an agreeable taste. Bread or mush made of the meal is very good and not to be despised.

Lepidium fremontii, L. intermedium, Sisymbrium sophia, S. canescens.—The seeds of all these plants are ground up with other seeds to impart flavor, and cooked into bread or gruel. Sometimes they are eaten separately or even in soups. Many of the western Indians use these seeds unmixed as food.

Salvia columbariæ ; Chia of the Mexicans and Indians of Arizona, and New Mexico.—The seeds are used by them as food and medicine. Steeped in water they form a very nutritive drink for the sick. In the form of mush they resemble flax in properties and taste. In Mazatlan, Mexico, a drink prepared from the seed is sold in the streets. The meal forms a fine poultice for wounds, &c.

Medicago sativa, the introduced plant, alfalfa. The Pah-Utes use the seeds ground up and cooked into mush or gruel. The Indians and white settlers gather the tender branches and cook them as greens.

Miscellaneous.—Scirpus validus (Tule plant). The Indians of California make bread out of the pollen of this plant, and the root is eaten by many tribes either raw or made into bread. The leaves are woven into mats and are used to cover their huts.

Typha latifolia (cat-tail rush). The Pah-Utes eat the flowering ends, in the spring, raw or cooked. When boiled in water they are very tender, making good soup, which is considered a great delicacy.

Eriogonum inflatum.—The tender stems of this plant are rather acid, they are eaten raw by the Indians of Southern Utah.

Porphyra vulgaris, a sea weed commonly called Laver on our eastern coast. It is found in nearly all parts of the world at low tide. Many of the Indians along the Pacific coast eat this plant cooked as greens or with meat. It is much relished by Chinamen and is quite an article of commerce. The Chinamen residing along the coast, at low tides, gather this plant, which is easily taken from the rocks. It is then placed in round masses to dry, after which they are baled and sent to China. It sells from five to eight cents per pound in San Francisco at wholesale, to be shipped to China.

Caulanthus crassicaulis and *Stanleya pinnatifida* are eaten raw in the spring by the Pah-Ute Indians, the young plants being tender, and when cooked taste like cabbage. For this reason these plants are called cabbage by the settlers of Utah. The Indians gather the seeds and after reducing them to flour make them into mush.

Cotyledon lanceolata, C. pulverulenta, &c.—The tender leaves of these plants in spring are eaten raw by the Indians of Southern California ; their soft, succulent nature causes them to be prized

by some white people. As they grow in places not contiguous to water, the moist leaves are used to quench thirst.

Aphyllon californicum and *A. ludovicianum*, are parasitic plants that grow upon the roots of many species. All the plant except the bloom grows under ground, and consequently is nearly all very white and succulent. The Pah-Utes consume great numbers of them in summer while on their hunting excursions after rabbits. Being succulent they answer for food and drink on these sandy plains, and, indeed, are often called "sand-food."

Hemizonia fasciculata, Tar-weed.—This plant in case of hunger is eaten by the Indians of Southern California after being cooked in the following manner: A quantity of the plants are boiled down until the liquid is of a thick tarry consistency, when it is ready for the stomach of the Indian. Its tar-like taste is objected to by some. A youthful brave was very careful to inform me that young Indians never eat that stuff. If the procuring and cooking of the same depended upon the young Indians (males), they would go hungry a long time, for their laziness scarcely stimulates them to collect food; even if hungry they expect everything to be done by the older females.

Madaria elegans.—The seeds of this species of tar-weed are ground into flour, made into thin cakes, and baked in hot ashes by the California Indians. When cooked the bread has a gray but not very inviting look, yet the Indian eats it without complaint though he prefers corn bread.

Arundo phragmitis, a species of cane growing along water courses and about springs in Southern Utah. Numerous small insects puncture the leaves of this plant and a liquid exudes. While in a soft state it is scraped off by the Indians with their long finger nails and eaten. At first it has a paste-like softness, but hardens like gum arabic, with a sugar candy density and color, having a rather sweet, gummy, licorice taste. When the exudations are sufficiently hardened the cane is cut and laid in bundles on blankets, the manna-like food is then easily shaken off. This substance if mixed with water forms a pleasant, nutritious drink, highly prized by the Indians who call it Pah-gump-pea-abbah.

Honey.—Since the introduction of bees to the Pacific coast the Indians have acquired a taste for honey. The climate being mild the bees increase rapidly and many swarms yearly escape to trees

and rocks, thus giving the Indian a chance to obtain the honey. Some California Indians have domesticated the wild bees. In Southern California the Indians cut down the trees containing bees, put them in a sack, carry away the honey to eat and sell the bees for one dollar a swarm, the purchaser taking all risks of getting a queen. Bees in a sack, for sale by an Indian, are surely a novel article of trade.

[*To be Concluded.*]

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THE ANCIENT PUÉBLOS, OR THE RUINS OF THE VALLEY OF THE RIO SAN JUAN.

BY EDWIN A. BARBER.

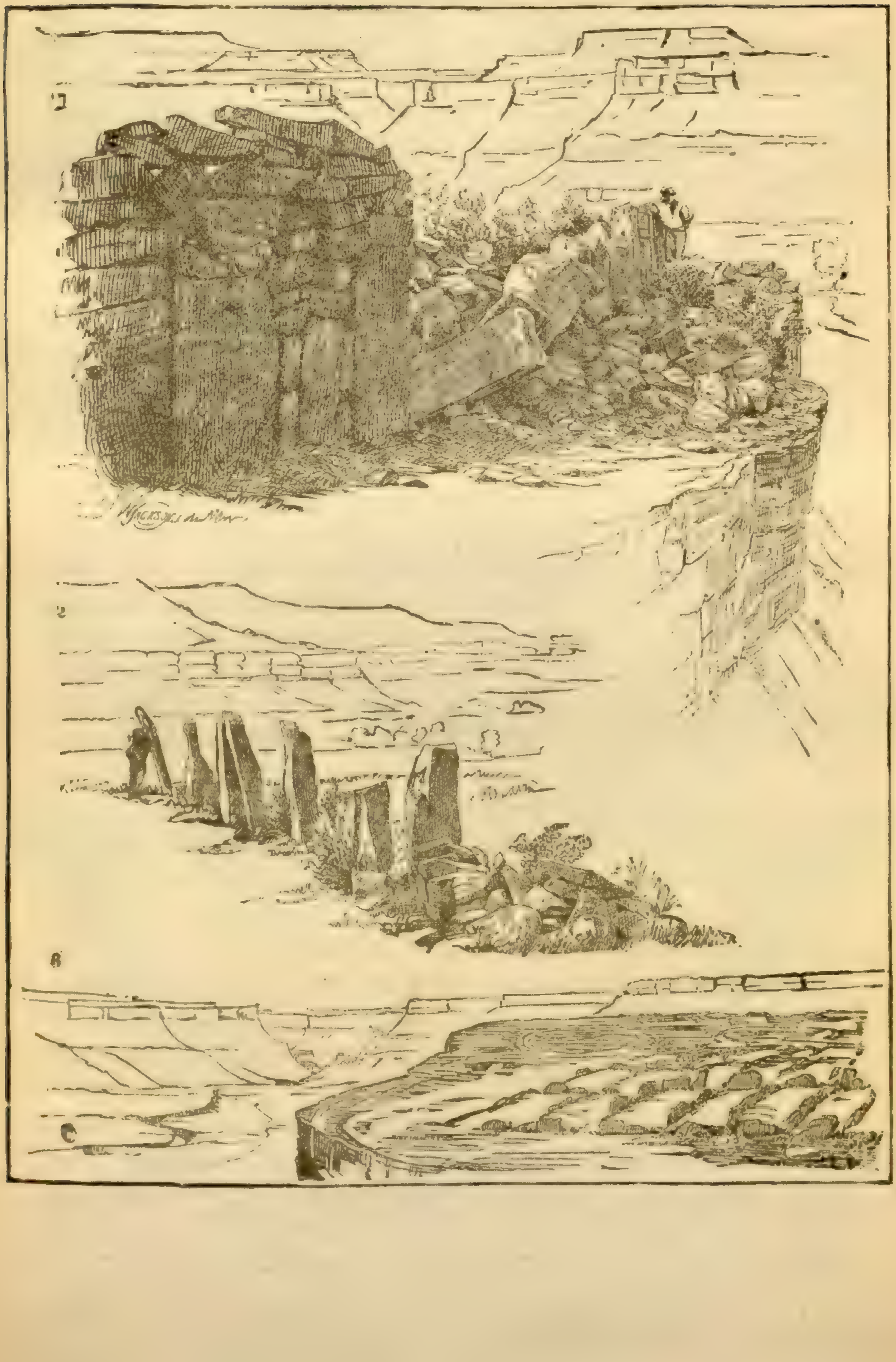
PART II.

ALMOST peculiar style of architecture prevails in the Montezuma cañon, in south-eastern Utah, which is entirely different from anything that occurs elsewhere. For instance, on a little island-plateau, rising from the middle of the valley to a height of forty feet, are the walls of a considerable edifice. Long narrow stones, measuring from four to seven feet in length and a foot or so in their other dimensions, have been set up like posts in a fence, standing at different distances apart, from two to ten feet. Between these the spaces have been filled in after the usual style of masonry. Some of the slabs are now standing at an inclination of several degrees, having been pushed outward by the accumulating *débris* inside. These are imbedded in the earth only to a depth of a few inches or a foot (See fig. 1, plate v., also fig. 1, plate vi).

Further down the cañon a somewhat similar ruin may be seen. Along the eastern side of a great parallelogram stand seven of these upright stones, some of them measuring, above the surface of the soil, nine feet. In their general appearance they somewhat resemble the dolmens or sacred stones of the Eastern Hemisphere, but evidently they had not been used for religious purposes. They had been built in the walls like pillars for the purpose of strengthening the original structures (See fig. 2, plate v).

The remaining figure on this plate (3), represents a group of

PLATE V.



ancient Puéblo graves, marked off by stones set on edge in the earth.

In one of the side cañons, near an isolated group of mountains, in south-eastern Utah, called on the map the Sierra Abajo, some diminutive store-houses or *caches* are perched in the bluffs, between the layers of rocks. They are supposed to have once been used for the storage of supplies, as their small size precludes all possibility of their ever having been occupied as places of abode. They have been made to resemble the surrounding rock-formation so closely that only the sharpest eyes can detect them, and then only when in the closest proximity. Nothing can now be discovered in them save the mouldering bones and *débris* of small animals, and in some instances traces of fire. If their builders left anything when they departed, all such objects have been removed by the vandal Indians who still infest the country.[1]

In passing down the valley of the Rio San Juan, some miles below the mouth of Montezuma cañon, a most interesting structure may be observed on the south bank of the river. This is a long, narrow building, extending around the back of a hemispherical cave, two hundred feet in diameter. The house consists of a number of rooms arranged around the arc of the semi-circumference of the cavern, and the walls in some places still attain the height of two stories, which, together, measure about twelve feet. Above the masonry, on the sand-stone walls, many pictures or outlines of human hands had been painted. These were accomplished by placing hands against the rock and spattering mud around them. This was evidently done by the laborers in idle moments as they rested from their work. In one of the small compartments, a circular fire-place, two and a half feet in diameter, had been cut in the stone floor. In an open space separating two of the rooms, four post holes had been drilled in the rock, in which, doubtless, the looms of the inhabitants had been placed (See fig. 3, plate vi). Many fragments and impressions of corn-cobs were observed in the mortar, and cedar twigs, bent in the form of loops, were still protruding from the external walls, from which, formerly, water-vessels and other utensils might have been suspended. The windows of the house were small apertures about eighteen inches square, while there were

[1] Vide "American Antiquarian," Vol. i, No. 1.

PLATE VI.

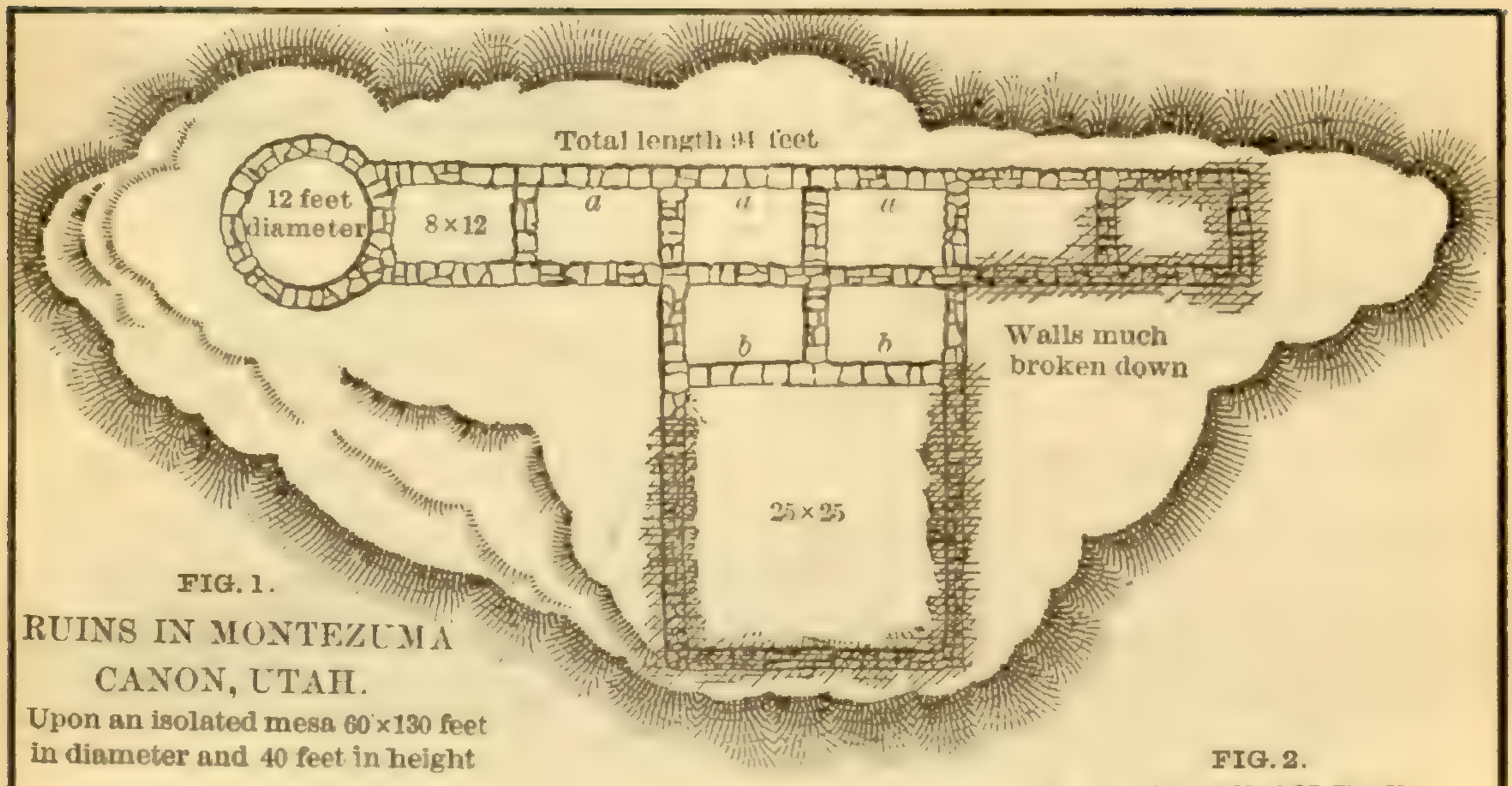


FIG. 1.

RUINS IN MONTEZUMA CANON, UTAH.

Upon an isolated mesa 60×130 feet in diameter and 40 feet in height

FIG. 2.

RUINS UPON THE RIO SAN JUAN

FIG. 3.

HORIZONTAL SECTION of the GREAT ECHO CAVE on the RIO SAN JUAN

Row of 11 Rooms, one story in height, from 4 to 10 feet in width, and 130 in length

no indications of door-ways. The rooms were connected internally by openings, but the building was entered from the exterior by ladders placed against the walls. We named the place *Casa del Eco* (the house of the echo) from the discovery that words spoken below the building, at the mouth of the cave, were distinctly repeated, producing at first a most startling effect.

Near the Casa del Eco and on the northern bank of the Rio San Juan, another important group of buildings was discovered, the ground plan of which may be seen in fig. 2, plate vi. The walls had entirely disappeared, scarcely one stone standing on another, but the plan of the original structure could be readily traced.

Thus far I have confined my descriptions, with one exception, to some of the mouldering ruins which are to be found in the cañons and cliffs of the *northern* tributaries of the San Juan river. To the south of this stream and in the valley drained by it, these same remains occur numerously in New Mexico and Arizona. Along the Rio de Chelly, for instance (an intermittent *arroyo* which penetrates northwardly through Arizona and joins the San Juan at the head of its cañon), there are many ancient structures which present some novel and striking features in pre-historic architecture. About eight miles from the mouth of the Chelly is a collection of cliff-buildings which extends uninterruptedly for a distance of nearly six hundred feet along a rock-recess, fifty feet above the river-bed. The walls of some of the dwellings are still standing *three stories high*, and one of the houses is so perfectly preserved that its wooden roof, constructed of cedar poles, still remains intact. This *Puéblo de Chelly* is the most extensive cliff-settlement yet discovered in this region, and photographs of it could be only obtained in sections. Fig. 3 of plate vii represents the southern or right-hand end of the communal building, while figure 2 shows the northern extremity of the group. The structure consists of about seventy-six rooms or apartments on the ground floor, the plan of which may be seen in figure 1. Below the walls, seven large burial urns were unearthed, and while photographing the ruins, nearly a hundred beautifully fashioned arrow-points and several fine specimens of pottery were picked up. Across the channel of the stream, in the open valley, an extensive graveyard may be seen, in which the resting-places of the departed have been marked out in the Puéblo manner by flat stones set on edge. In some instances the heads of the graves have been indicated by tall headstones.

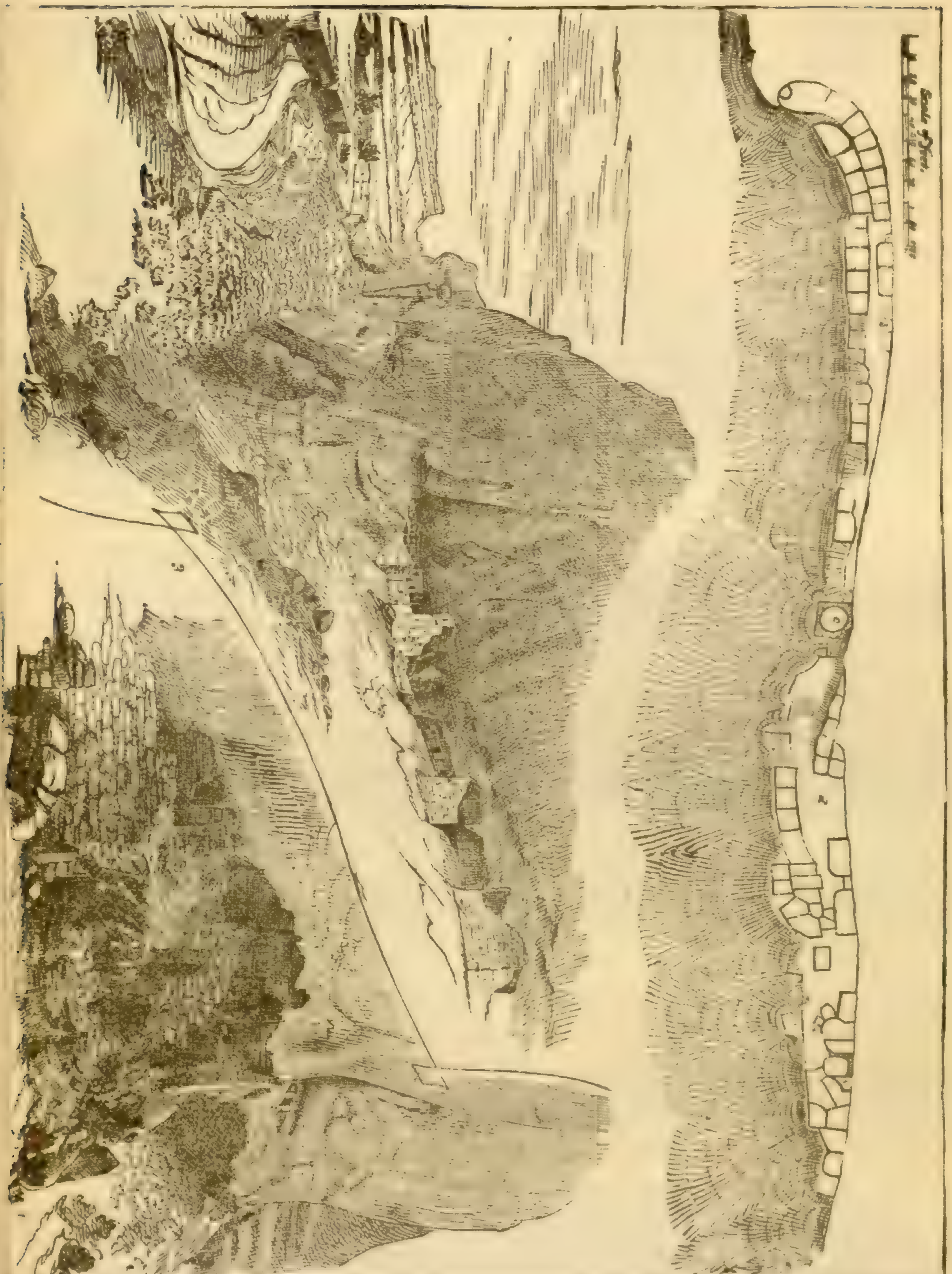


PLATE VII.

In the preceding pages of this article I have simply attempted to give a general idea of the main features in the ancient Puéblo architecture. Many other equally interesting ruins might be described, but it is unnecessary to pursue the subject farther at present. These ruins are similar to those of the Chaco cañon to the south, in New Mexico, which were first brought to light by Lieut. Simpson in 1849. In writing of these latter, Mr. W. H. Jackson remarks: "In all the ruined puéblos, the most remarkable feature was the skill with which the stone walls were built, and which has enabled them to withstand, for hundreds of years, the ravages of human hands and the slower work of the elements. Beginning at the foundation with a width of thirty-two inches, each succeeding story was built a little less in thickness, until the walls of the fourth floor were about eighteen inches through, giving them a pyramidal shape, and of such solidity that in some cases, although the floor has been crushed down and the cross walls fallen, they yet remain firm and plumb nearly forty feet in height. They had three methods of laying the stones: by regular sandstone blocks of the size of two bricks, cut and ground uniformly; by alternate layers of these blocks with very small and thin pieces of sandstone, generally three courses of the thin to one of the thick; and last by laying the entire wall of these excessively small pieces of thin sandstone. As an example of this last kind, I measured off a square yard on the northern wall of the Puéblo of *Chetho Ketle*, and counted the number of stones forming the surface. There were 450, laid so closely together that a knife-blade could not be pushed between, and not a particle of mortar of any kind appeared at the surface This entire wall was 400 feet long and originally fully forty feet high and averaged twenty-four inches thick. Imagine the industry and patience of such builders. Every doorway and window was framed with scrupulous exactness, and it would appear as if the plumb and square had been faithfully used in all their work."

In reviewing the above stated facts we would naturally be inclined to doubt the high antiquity of these works of art. But it must be remembered that the conditions were exceedingly favorable for the indefinite preservation of mural constructions. The equability of the atmosphere and the aridity of the soil must be taken into consideration. It is true that we find among these ruins traces of timber which, under ordinary circumstances, is

exceedingly perishable; but the wood which occurs is generally of the most durable sort, such as cedar and *artemisia*. The exsiccating properties of the desert atmosphere would be eminently conducive to its preservation, and it might remain intact for many centuries. On the other hand, we must not lose sight of the fact that in the majority of instances the wood-work of these structures has entirely disappeared. Only in exceptional cases do we find traces of vegetable fibre in the ancient remains. This fact alone would be sufficient to prove conclusively the great age of the buildings. In a country where scarcely a drop of rain falls from one year's end to another, and where the temperature varies but a few degrees throughout the 365 days, a great length of time would be required for the gradual disintegration of the most durable woods and particularly of solid rock. Yet there existed at one time thousands of stone and adobe structures throughout the San Juan valley, which can at present only be traced by inconsiderable mounds of dust. It is now generally held that the ancient Puéblos were a progressive branch of the so-called Mound-builders, forming a connecting link between the latter and the Nahuatl tribes of Mexico.

Frederick von Hellwald,[1] in an article on "The American Migration," says:

"If, then, it is permitted us to conclude from analogy, which is no uncertain guide when like causes operate under like conditions, the populations of the copper age of America, which had already dawned in the region of the lakes, would have followed the valleys of the Ohio and Mississippi, and then have directed their steps through the present States of Louisiana and Texas, probably along the edge of the gentle acclivity which, under the name of the Sierra Guadalupe, stretches from the Rio Grande to the Rio Brazos, towards the banks of the great Rio Grande del Norte.

"There are many indications, moreover, which lead us to believe that this was not the only route by which the northern tribes made their way to the south. A part of them seem to have become detached in the Mississippi valley, and to have projected themselves towards the south-east into Florida, the seat of a higher civilization, whence they eventually proceeded to Cuba and Yucatan; while a branch of them traversing the whole length of Cuba and the great arch of the Caribbean islands, descended finally to the banks of the Oronoco. This fraction of the migratory population may, of course, have

[1] Smithsonian Report, 1866. Translated by C. A. Alexander.

been small and its impetus inconsiderable, since the necessity of maritime transport, though only from island to island, would naturally impair its force. In the opinions of others, and among them Humboldt, even the Rocky Mountains in their extension northward may have led similar branches of emigrants to adopt a different path in their progress towards the south. Whether these branches originally issued from the lake regions, though it is not impossible, is difficult to determine. They must at any rate, in departing from their homes, have taken a directly west or at least south-west direction. Although no substantial reasons can be assigned why any race of those latitudes should have given a preference to the toilsome defiles of the Rocky mountains, when the fair and commodious plains and prairies of the south lay before them, yet too many points of apparent connection present themselves to admit of our consigning their adoption of such a route to the category of impossibilities.

"It is from the Rio Gila that we are first enabled to perceive definite traces of the course of the migration into the regions of the south; the indications of the different stages of its progress increase with its entrance upon Mexican territory, but we yet possess only sparingly the means of identification. The first immigrants who appeared in the north of Mexico brought with them the so-called Toltecatl civilization, the work of the races of the great Nahoa family. * * * *

"If we admit that the age of the civilization indicated in the region of the Mississippi reaches back 2,000 years, it is not impossible that the Nahoas were also the builders of the earth-mounds in North America, or at least belonged to the race from which these works proceeded. As regards the stone structures of the great *casas* of El Zape and La Quemada, we cannot but infer that their builders must have been long permanently settled in those districts, which accords much better with later researches than the assumption of many that the immigrating tribes had merely halted in the places for a few years, perhaps a quarter of a century, and in that time had erected these monuments."

A. Marlot observes, in his "General Views on Archæology," "It is finally worthy of remark that the 'mound-builders,' as the Americans call the race of the copper-age, seem to have preceded and prepared the Mexican civilization, destroyed by the Spaniards; for in progressing southwards, a gradual transition is noticed from the ancient earthworks of the Mississippi valley to the more modern constructions of Mexico, as found by Cortez." (Translated by Philip Harry, Esq., for the Smithsonian Report for 1860.)

In concluding the subject, I wish to extend my thanks to Prof. F. V. Hayden, through whose courtesy the illustrations for these papers have been furnished.

AN INTERESTING CASE OF NATURAL SELECTION.

SAMUEL F. CLARKE.

IN the early part of last spring I obtained a large number of the gelatinous egg-masses of one of our native salamanders or newts (probably *Amblystoma opacum*). They had been deposited in a small pond of clear water, in the edge of a wood just outside the city.

These egg-masses, or bunches of eggs, vary greatly in size, the smallest being no larger than an English walnut and containing only from five to eight eggs, while the largest bunches are from six to eight inches long, more or less oval in shape, and contain from one hundred and fifty to two hundred eggs. The bunches are usually attached to some water-plant or to an overhanging blade of grass, and the gelatinous matter is so translucent that the dark, opaque eggs may readily be seen through it. Each egg is surrounded by two membranes, between which there is quite a space; and as this space, as well as that within the inner membrane, is filled with fluid, an admirable arrangement is thus secured for protecting the embryos from any injury to which they might be exposed by coming in contact with any hard, unyielding body.

The eggs were kept in large glass jars and developed quite rapidly, the rate of growth seeming to depend upon the purity and temperature of the water. After their gills and balancers were developed, they emerged from the eggs and began their active life in the water. And now I found trouble in keeping them, for I was unable to find what they wanted for food. I tried various things but did not succeed in pleasing them. Upon watching them closely I soon found that they had developed cannabalistic tendencies and were eating off one another's gills. This led me to study their movements still more closely, when I soon discovered that among the many there were a few, who although they came from the same parents and were subjected to the same conditions while in the egg, were yet gifted with greater vigor and energy than most of their brothers and sisters or cousins. These few stronger ones eat off the gills of many of the weaker ones and at the same time were enabled to protect their own from mutilation or destruction.

These favorable conditions, the large supply of food and the better aeration of the blood, soon began to show their influence upon the growth of the individuals thus favored. Within a week

or ten days from the escape from the egg, these favored few were fifty per cent. larger than their weaker comrades who were born upon the same day. Their mouths had by this time increased so much in size that they were no longer satisfied with nibbling off the gills of their brethren, but now began to swallow them bodily. This great increase in the supply of food soon produced a marked effect upon those who were thus supplied; so that in ten days from the time that they began to feed in this way they were from ten to twelve times the length and bulk of those upon whom they were feeding. Developing at this rapid rate, they arrived at the stage when the gills are re-sorbed and the abranchiate form leaves the water for the marshy land or old, damp log, where it usually makes its home and where it would find a supply of more natural food-material.

Here then was a very interesting case of natural selection, by survival of the fittest. All the weaker individuals being destroyed and actually aiding the stronger ones by serving them as food until they could pass through their changes and escape to other regions where food was more abundant.

——:o:——

RECENT LITERATURE.

FLÖGEL ON THE STRUCTURE OF THE BRAIN IN DIFFERENT ORDERS OF INSECTS.—The Supplementary Heft for May 28th of Siebold and Kölliker's *Zeitschrift für Wissenschaftliche Zoologie* contains an elaborate article by J. H. L. Flögel, illustrated by a number of micro-photographs. This and Dietl's excellent paper, published in 1876, are the only treatises on the minute structure of the brain of insects, Owskianikof having studied that of the spiny lobster (Palinurus) several years ago, while Dietl studied the brain of Astacus. Flögel establishes three points as the results of his researches.

First, the constant presence of the remarkable central body in the mature insects of all orders, while it is almost absent in the larvæ of Lepidoptera (but not in Hymenopterous larvæ). We are thus led to suppose that it has something to do with the formation of the faceted eyes. If it has any relation with the bundle of fibres passing from the optic lobe, there is nothing to indicate it.

Secondly, the size of the olfactory lobe, with its olfactory bodies, correlated in insects with small antennæ entirely unfit for tasting, but on the contrary with a very completely developed sense of smell, is in the author's opinion an excellent proof of the correctness of Leydig's view that the antennæ are organs of smell, whatever may be brought forward in opposition to it. If they are to be interpreted as an apparatus for detecting sounds,

we, on the other hand, are acquainted with the finer structure of the organs of hearing in the Orthoptera, and know that they have no such constituted brain-centres as the olfactory lobes.

Thirdly, Flögel draws attention to the wonderful and so little understood facts that in insects, where the lobes ("bechers" of Flögel, "lappen," "gestielte körper," etc., of Dietl) and the substance around it (gerüst) constitute the greater part of the brain, there is indeed no connection of the nerve-fibres to be found with the remaining parts of the brain, and consequently also with the œsophageal commissures. The opinion that the ganglionic cells are in direct relation through fibres with the organs of the body is provisionally unfortunately contradicted. But where are the intermediate stations? he asks.

Finally, the author claims that the essay indicates the outlines of a future brain-topography for insects, and shows that the single parts of the brain have their homologues in the different orders of insects; consequently a ground-plan in the organization is not to be mistaken, and thus a comparative anatomy of the brain of insects is outlined comparable with that of the vertebrates, as established by the researches of Stieda.

Barrois' Embryology of Bryozoa.[1]—The author of this elaborate and beautifully illustrated memoir is well-known for his able and thorough work on the development of the sponges and nemertean worms. A large number of typical forms of Polyzoa or Bryozoa, as the German and French call them, have been studied, and the different stages figured, including the genera Loxosoma, Pedicellina, and several genera of higher marine forms. We will give the general results of our author's work condensed from the *résumé général*. A study of the different groups of Chilostomatous and Cyclostomatous Polyzoa, shows that their development presents the same phenomena, characterized by the great regularity of the segmentation (*morula*) and giving rise to a *blastula*, in which the advanced morula is composed of two distinct halves (oral and aboral) separated by a crown of cilia. Then the *gastrula* state is assumed and afterwards the mesoderm arises. At the moment of birth, the embryo always withdraws the aboral end within the crown and thus assumes a discoidal aspect, but it can undergo this process much more rapidly, previous to the appearance of the fur-

Fig. 1. Fig. 2.

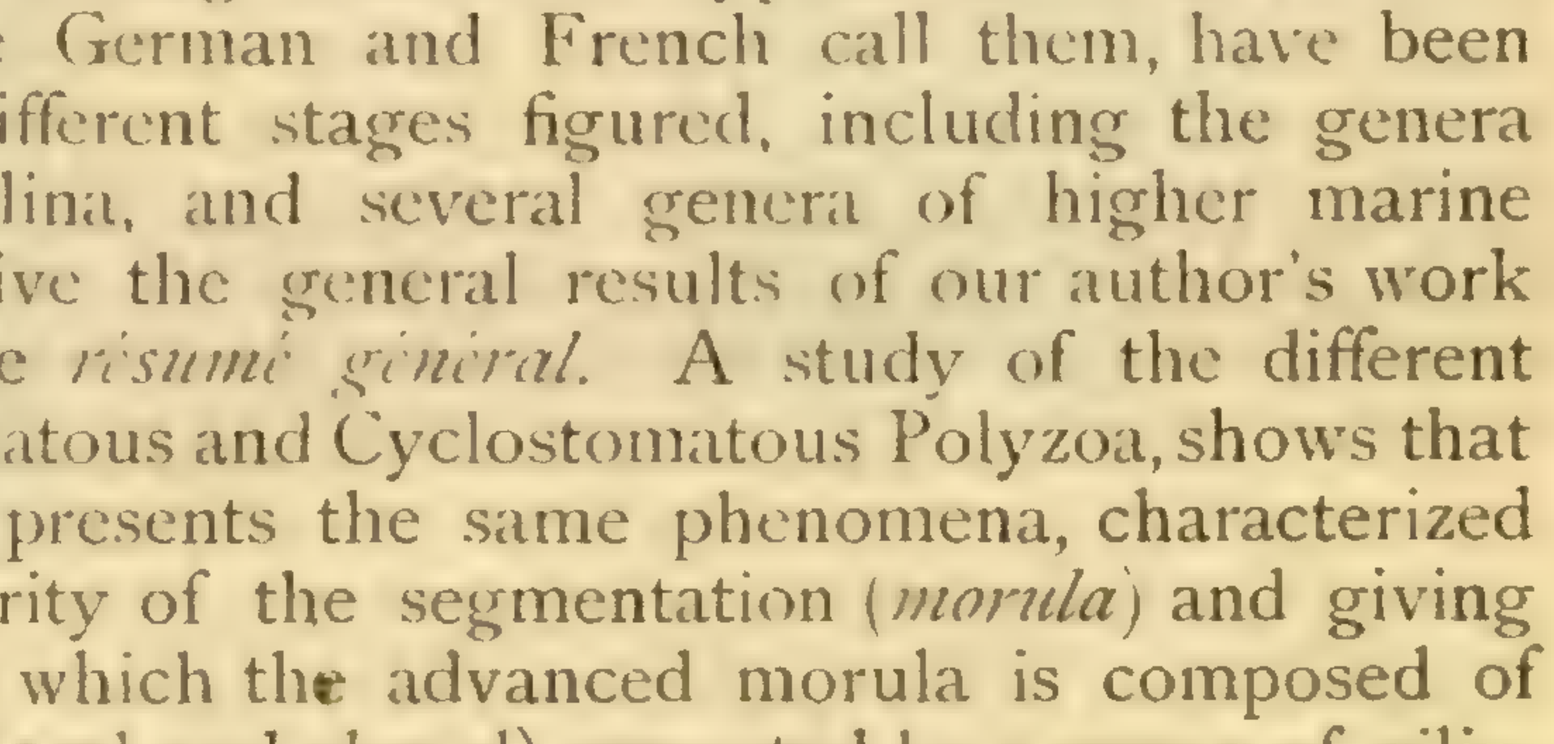


Fig. 1.—Blastula of *Alcyonidium mytili*. Fig. 2.—Gastrula of the same; *c*, beginning of crown.

[1] *Recherches sur l'Embryologie des Bryozoaires.* Par J. Barrois. Lille, 1877. 4°, pp. 305, with 16 plates.

row, so that we are led to distinguish in certain types, the presence a little after the gastrula stage of a stage with an aboral mass and extended or widened face separated one from the other by the furrow (Fig. 3, *sb*). Hence he distinguishes two fundamental forms; that which presents in the embryos the division into an aboral and extended face (Alcyonidian or pedunculate form), and that in which the furrow is wanting, constituting the Escharine or sessile form. Barrois considers that the latter is the original form, and that the Alcyonidian form (Fig. 4[1]) is derived from it.

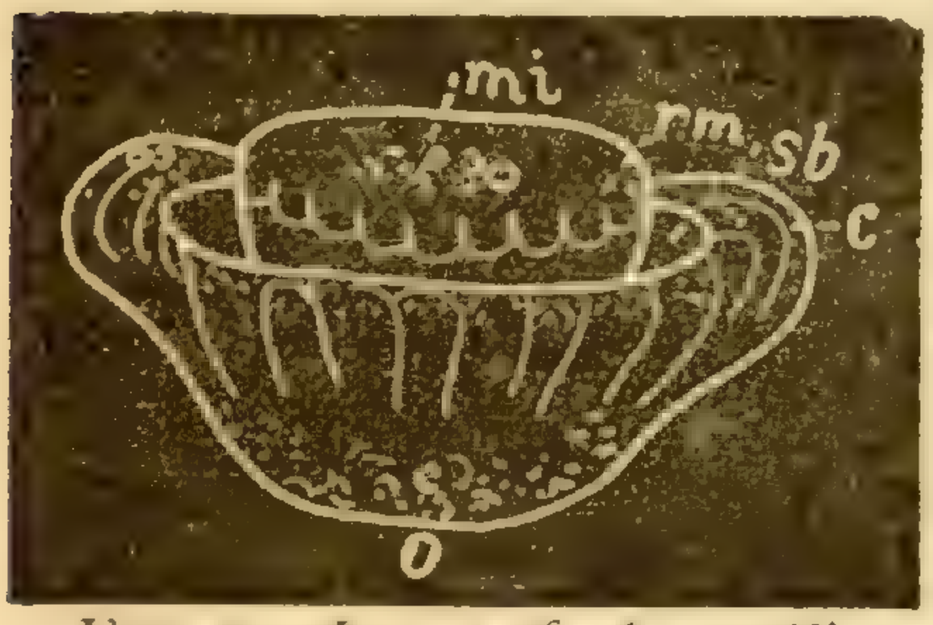


FIG. 3.—Larva of *A. mytili*.

The formation of the recurved intestine of the Polyzoa results from a closure of the opening of the digestive cavity, analogous to the closure of the blastoderm in Clepsine and in Euaxes. The Ectoprocts pass during the period of their development through an Entoproctous condition in which the part which represents the intratentacular space or basilar plate, which separates the digestive cavity from the cavity of the sheath, contains the two openings of the digestive tube, and is completely encircled by the tentacles.

Barrois thinks, contrary to Allman, that it is much more natural to consider the Ectoprocta as organisms throughout comparable to Entoprocta, but in which the anus curves within the tentacular crown, as he had shown to be the case at the time when the tentacles bud out; and it is very improbable that the transitory state in which the crown is interrupted on the anal side is the point of departure of the formation of the lophopore; we shall thus have a general phylogeny of the class of Polyzoa, based on the evolution of the tentacular crown, and disposed as follows: Entoproctes—Lophopodes—Gymnolemes.

He considers that all the different larval forms of Polyzoa may be reduced to a single type composed of a gastrula with two opposite faces or ends separated by the crown, one (aboral) bearing in its centre the buccal opening, and capable of being covered so as to form the vestibule; all the larvæ possess a median muscular or fatty layer (*mi*), which is generally composed of a portion formed by the oral face (labial mesoderm) and of a portion dependent from the aboral face; this last is more constant, more voluminous, and constitutes the essential portion of the mesoderm; it is derived in most cases from a simple delamination of the exoderm, but in the Entoproctes, the intestine appears also to take part in its formation; it is even possible in Pedicellina that it is derived from a fold at the end of the intestine, and that we may find in the Polyzoa some traces of an enterocœle.

From this primitive type, already very complex, the larvæ of the Entoproctes are derived by a differentiation of the mesodermic

[1] In all the figures *o* indicates the mouth; *sb* and *si*, the furrow; *c*, the crown of cilia, *mi*, aboral mesoderm; *c*, ciliated crown; *est*, stomach.

masses, which place themselves in relation with the skin at three different points to form the three tactile organs. The larvæ of the Cyclostomes are formed by an extension of the crown in the form of a mouth on the aboral face, and finally the larvæ of the Chilostomes (Fig. 4) and Ctenostomes arise by a division of the aboral face into two parts, the cupping glass-like part (*ventouse*) and lower part, resulting from the withdrawal of this same face.

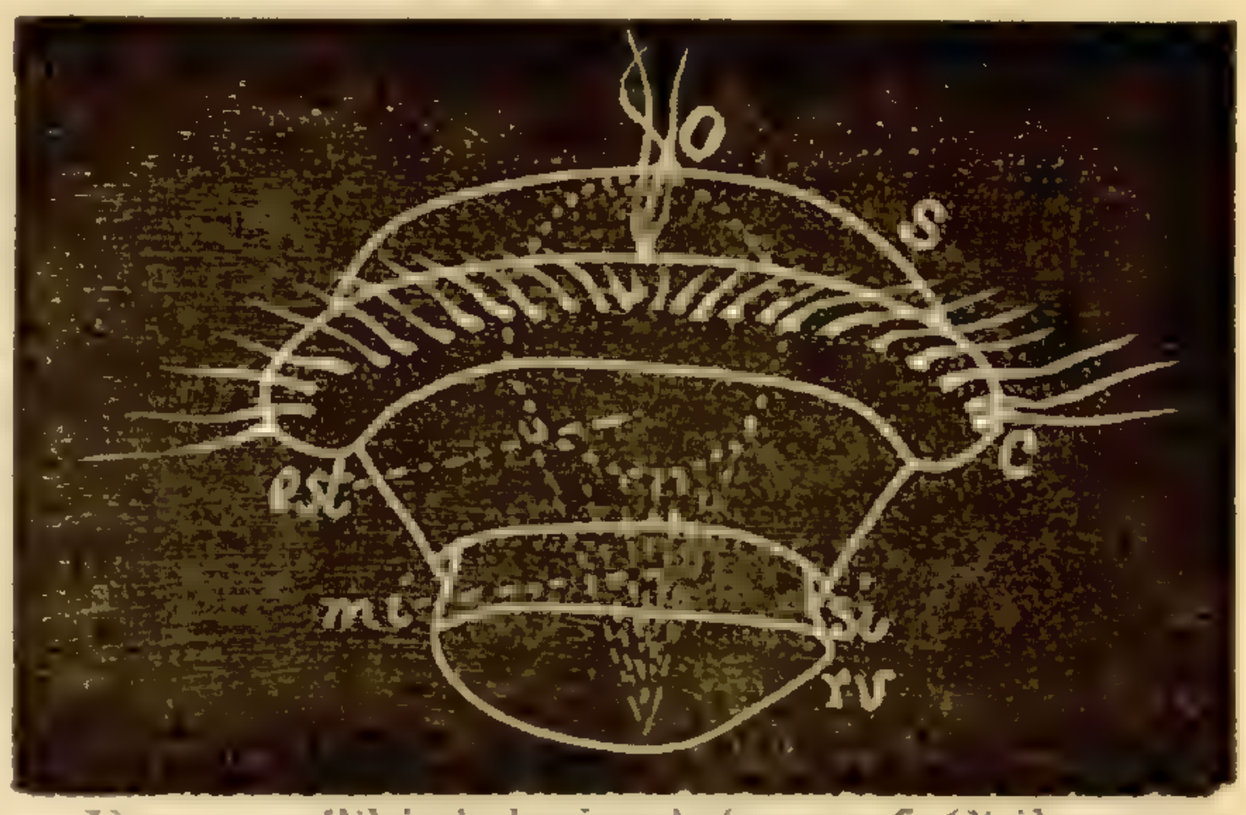


Fig. 4.—Third derived form of Chilostome larva.

Our author then compares the larval form of Polyzoa with those of the Rotifera, and compares their ciliary crown with the rotary organ of Rotifers, the thoracic segment of Brachiopod larvæ and the ciliated crown of the Trochosphere of molluscs and worms, and find a strong similarity between them. He accepts the Trochosphere-forms of Rotifers, Polyzoa, Brachiopodes, Molluscs and Annelids, and thinks that there are essentially two forms, the first giving rise to the Polyzoa, the second to the Brachiopods, Molluscs and Annelids; the first group having the ciliary crown placed below the mouth, and the second and last having the crown of cilia placed above the mouth. He is of the opinion that the Polyzoa on embryological grounds are, on the whole, closely related to the Brachiopods and Rotifers, and from the general resemblance of the larvæ of the entoproctous Polyzoa to the Rotifers he concludes

Fig. 5.—A Rotifer.

Fig. 6.—Annelid larva

Fig. 7.—Polyzoan larva.

Fig. 8.—Branchiopod larva.

that they have the most intimate relation with the latter. After swimming about as ciliated larvæ, the shell or ectocyst develops and the larva becoming stationary, soon assumes the mature Polyzoan condition.

The description of the metamorphosis and mode of budding of the polypite in the different forms is fully detailed and illustrated by beautiful figures. As seen in *Phalangella flabellans* (Cyclostomes) the larva, after becoming fixed to some object, consists of a white pyriform mass, closely enveloped by an ectocyst, with numerous fat globules between the latter and the white mass. The ectocyst swells into a discoidal sac, with endocyst, ectocyst, and an external anhistic zone, while the internal whitish mass transforms into the polypide. The discoidal sac formed by the endocyst constitutes simply the basal disc of the primitive cell. The future opening of the cell appears on the upper surface of the cell. The budding out of the secondary cells of the polyzoarium is then described. It begins by the appearance of a cell placed in front and below the primitive cell, and which borders it on each side; its secondary cell then divides into two, each of which gives successively origin to three cells, and we thus arrive at an Idmonea stage, and finally the Phalangella stage is reached, the process being a dichotomous mode of budding quite analogous to that which produces the cormus, spread out in plates, of Escharina.

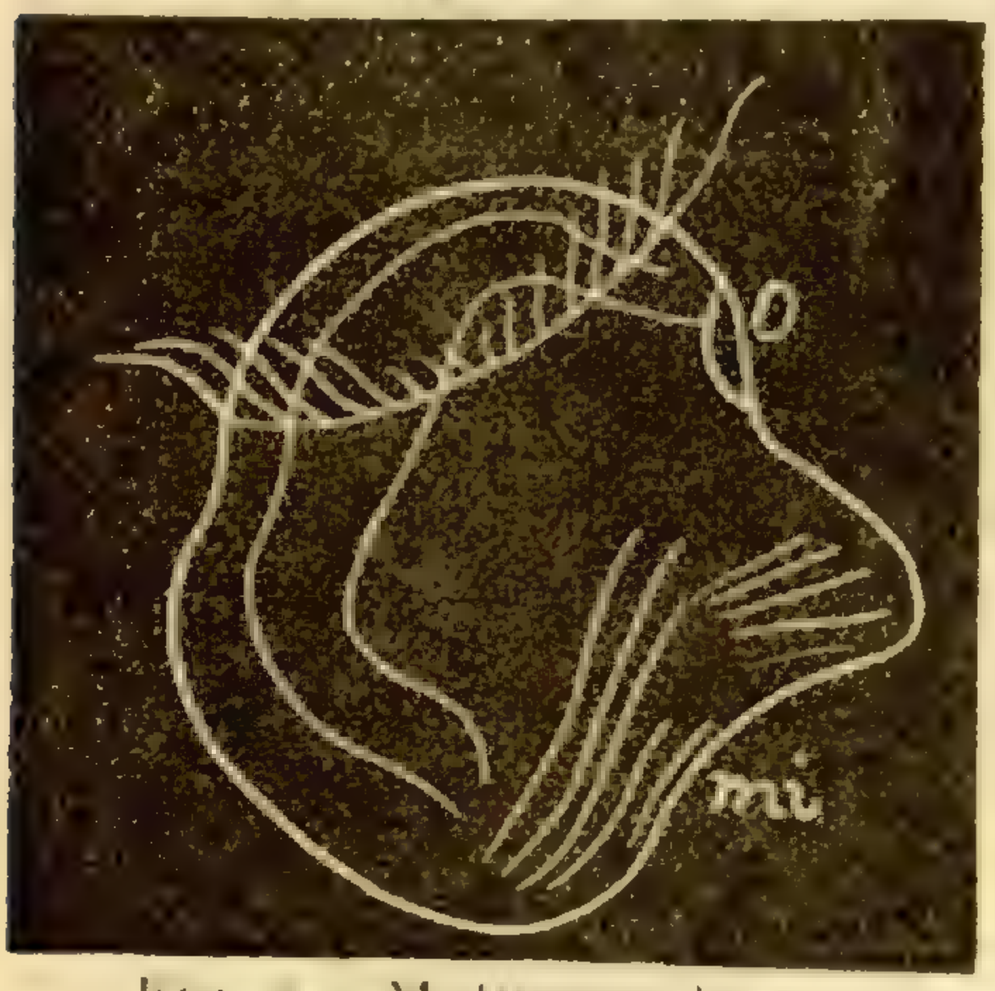


FIG. 9.—Molluscan larva.

FIG. 10.—*Porella lævis*, primitive cell almost complete. *Pol*, polypide; *g*, fat cells. *sp*. rudimentary spines; *ol*, opening of the cell.

The development of *Membranipora pilosa* is given with much detail. The larva of this species is provided with a bivalve shell, so that it was by Semper and Claparède considered as a Lamellibranchiate larva, but was proved to be a young Polyzoan by Schneider, in 1869. Barrois finds it impossible to compare the shell of this larva to that of the Lamellibranchiates, and considers its metamorphosis as like that of other Chilostomes.

The work must be considered as the most important general treatise on the development of Polyzoa in existence, that of Nitsche being less complete, though of a high order of excellence.

FRAZER'S REPORTS OF PROGRESS IN THE DISTRICT OF YORK, ADAMS, CUMBERLAND AND FRANKLIN COUNTIES, PENNSYLVANIA.[1]—Reports C of the Second Geological Survey of Pennsylvania, and

[1] *Second Geological Survey of Pennsylvania.* Published by the Board of Commissioners. J. B. Pearce, Secretary; J. P. Lesley, State Geologist. 1876.

CC, CCC, etc., relate to the counties lying in the south-east angle of the State, which have been assigned to Prof. Frazer.

Report C, 1874, is devoted to a study of York and Adams counties, but more particularly the former. Pages 1 to 77 describe 126 ore banks, both new and old (at that date), and their correct location on the general map renders apparent for the first time a law governing their position in definite horizons. Pages 78 to 87 describe Section 1. The description differs from the same section as given by Rogers in some important particulars. In it the first reliable measurement of the perpendicular thickness of the "Auroral" limestone, made during the survey, finds place. Prof. Rogers took the clearly marked planes of fine lamination for cleavage and occasional joints of low angle for that of fine bedding; by which means he reduced the total thickness of the measures very much. In the synclinal, whose axis lies very near the Wrightsville—Columbia bridges, the thickness appears as 2800 feet +.

It may be remarked, as a new feature in delineation, that the symbols characterizing the different strata are continued for about 3000 feet above the line of ocean level as well as below it, the present surface being indicated by a profile. This permits a more comprehensive view of the differences between formations, emphasizes faults, and hints at the possible amount of erosion.

Section No. 2, across the mesozoic beds, is interesting as exhibiting an anticlinal on their southern margin. On pp. 104–114 some chemical and structural differences are shown to obtain among the limestones united under the name of Auroral. Later we have an interesting chemical and microscopic analysis of the dolerytes of Adams county, in which they are shown to differ from those of Connecticut, in having two mol. Labradorite and one of Pyroxene.

Prof. Frazer's view of the origin of the limonites is favorable to their derivation, in the main, from the pyrite and carbonate of iron among the hydro-mica schists.

Report CC continues the result of the survey of York and Adams counties with part of that of Franklin. The important magnetic ore of Dillsburg is described, and some striking illustrations of the manner in which the ore and trap occur in these formations are given on p. 234. Several sections of the mesozoic red beds are given, one of which exhibits two small anticlinals as interrupting the uniformity of their north dip. Prof. Frazer devotes especial attention to the difficult question of the dynamics of this formation, which has so long puzzled geologists. By a geometrical method, as applied to their structure, he reaches the conclusion that the measures of the New Red have not been disturbed by uplifts, as has generally been assumed.

Thorough explorations of limited areas, such as are described in the present reports, furnish the most exact knowledge available

for scientific generalization as well as for economic statistics. From both points of view the volumes before us justify the wisdom of the creation and support of the Second Geological Survey of Pennsylvania.

FOURTEEN WEEKS IN ZOÖLOGY, BY J. DORMAN STEELE.—The following facts in Natural History, which will be new to most readers of the NATURALIST are taken from Steele's "Fourteen Weeks in Zoölogy,"[1] a work by a "born school-book writer," lately published to "meet the popular demand" for instruction in Zoölogy.

"*Lophiidæ* (crested).—The Fishing frog has the ventral fins forward of the pectoral. The latter serve as legs and enable it to hop about upon the beach. Upon the head are three spines—the first, with a shiny membrane at the tip, fastened by a ring-and-staple joint and able to move in every direction; the other two turning only backward and forward. The sluggish creature lies in the mud at the bottom of the water, and waving the first spine, attracts the curious fishes with this glistening bait; but, as they nibble, the rear spines knock them into its capacious mouth" (p. 190).

"*Percidæ* (dusky).—*Perch* are found both in salt and fresh water. Their operculum is so constructed that they can be kept alive in the air for hours by occasionally pouring water upon their gills" (p. 191).

"*Siluridæ*.—The Cat-fish, or Horned pout, has a naked skin, and the mouth surrounded by tentacles" (p. 195).

"The *Hydrozoa* (water-dragon animals) or Jelly fishes, have no mesenteric spaces, and the eggs are developed on the external instead of the internal surface of the body wall. Interspersing the tentacles and other parts of the body are cells containing long, spirally-coiled threads, barbed and serrated, which dart forth with inconceivable velocity to lasso their prey. * * * Mere transparent masses of jelly and only visible because of their brilliant colors, they move through the water rapidly and lasso their prey with great precision" (p. 271). And so on wherever one opens the book.

It seems to me, that we who believe in the study of nature as a "means of grace," ought to protest earnestly against such burlesques on science as this work and its companions. "I told them that I was not the man for such work, and I told them, too, that the less of such work that is done the better. It is not school-books we want, but students. The book of nature is always open, and all I can do or say shall be to make them study that book and not to pin their faith to any other" (AGASSIZ).—*D. S. J.*

[1] *Fourteen Weeks in Zoölogy*. By J. DORMAN STEELE, Ph. D., F. G. S., author of the Fourteen Weeks Series in Natural Science. A. S. Barnes & Co. New York, Chicago and New Orleans, 1877.

RECENT BOOKS AND PAMPHLETS.—Les Enchainements du Monde Animal dans les temps geologiques, Mammifères tertiares, par Albert Gaudry, Prof. de Paleont. au Mus. d'Hist. Naturelle de Paris. Avec 312 gravures dans le texte. 8vo, pp. 293. Paris, 1878. From the author.

Contributions to Palæontology, No. 2. By S. A. Miller and C. B. Dyer. 8vo, pp. 11, pls. 3 and 4. Cincinnati, July 22, 1878. From the authors.

The Sixth Annual Report of the Board of Directors of the Zoölogical Society of Philadelphia. 8vo, pp. 28. From the society.

A Catalogue of the Flowering Plants and Higher Cryptogams growing without cultivation within thirty miles of Yale College. Published by the Berzelius Society. 8vo, pp. 71, and map. New Haven, 1878. From the society.

Metasomatic Development of the Copper-bearing Rocks of Lake Superior. By Raphael Pumpelly. (Abstract from the Proc. Am. Acad. of Arts and Sciences. Vol. xiii.) 8vo, pp. 253–309.

Report of the State Commissioners of Fisheries for the year 1877. 8vo, pp. 38. Harrisburg, 1878.

The Columella and Stapes in some North American Turtles. By Sarah P. Monks. (Read before the Am. Philos. Soc., March 1, 1878.) 8vo, pp. 335–337, pls. 16 and 17. From the authoress.

On the Respiration of Amia. By Burt G. Wilder, of Ithaca, N. Y. (Proc. Am. Assoc., Nashville. August, 1877.) 8vo, pp. 306–313. From the author.

Boletin del Ministerio de Fomento de la República Mexicana. (Daily Meteorological Report.) Folio, pp. 2. Mexico, 1878. From M. Bárcena, Director.

Mexican Contributions to the Bulletin of International Meteorological Observations, taken simultaneously on March, 1878. Mexico. From M. Bárcena, Director.

A further contribution to the knowledge of the existing Ziphoid Whales, genus Mesoplodon. By William Henry Flower, F.R.S., V.P.Z.S. (From the Trans. Zoöl. Society, Vol. x, Pt. ix, 1878.) 4to, pp. 416–437, pls. lxxi–lxxiii. London, 1878. From the author.

Bibliography of North American Invertebrate Palæontology; being a report upon the publications that have hitherto been made upon the invertebrate palæontology of North America, including the West Indies and Greenland. By C. A. White M.D., and H. Alleyne Nicholson, M.D., D.Sc. (Miscel. Publications, No. 10, U. S. Geol. Surv. of Territories.) 8vo, pp. 132. Washington, 1878. From the Depart. of the Interior.

Bulletin of the United States Geological and Geographical Survey of the Territories, Vol. iv, No. 3. 8vo, pp. 544–745. Washington, 1878. From F. V. Hayden, U. S. Geologist.

New Specimen from the Water-lime Group at Buffalo, N. Y. By A. R. Grote and W. H. Pitt, of Buffalo, N. Y. (Proc. Am. Ass., Nashville, August, 1877.) 8vo, pp. 300–302. From the authors.

Notice of the Discovery of the position of the Crural Processes in the genus Atrypa. By William Gurley. (Read before Am. Philos. Soc., March 1, 1878. 8vo, pp. 337–338, and plate 14. From the author.

On the Annual Deposit of the Missouri river during the Post-pliocene. By J. E. Todd, of Tabor, Iowa. (Proc. Am. Ass., Nashville, August, 1877.) 8vo, pp. 287–291. From the author.

Descriptive Catalogue of Photographs of North American Indians. By W. H. Jackson, Photographer of the Survey. (Miscel. Publications, No. 9, U. S. Geolog. Surv. of the Territories.) 8vo, pp. i–iv, 124. Washington, 1877. From. F. V. Hayden, U. S. Geologist.

Preliminary Report of the Field Work of the U. S. Geological and Geographical Survey of the Territories for the Season of 1877. 8vo, pp. 35. Washington, 1877. From F. V. Hayden, Geologist-in-Charge.

Report of the Geological and Geographical Survey of the Rocky Mountain Region. By J. W. Powell. 8vo, pp. 19, with map. From the author.

Preliminary Report on the Palæontology of the Black Hills. By R. P. Whitfield.

Containing descriptions of new species of fossils from the Potsdam, Jurassic and Cretaceous formations of the Black Hills of Dakota. 8vo, pp. 49. Washington, 1877. From J. W. Powell.

Note additionélle au Mémoire sur les Phénomènes de la Digestion chez les Insectes (publie en 1874). Par Felix Plateau, Bruxelles, 1877. 8vo, pp. 25. From the author.

Recherches sur la Structure de l'Appareil Digestif et sur les Phénomènes de la Digestion chez les Araneides Dipneumones. Par Felix Plateau, Bruxelles, 1877. 8vo, pp. 136, 3 plates. From the author.

L'Instinct des Insectes, Peut-il être mis en Défaut par des Fleurs Artificielles? By M. Felix Plateau, Paris, 1876. 8vo, pp. 6.

Association Française pour l'avancement des Sciences, Congrès de Clermont—Terrand. Séance du 21 Août, 1876.

Geological Survey of Canada. Report of Progress for 1876–77. Alfred R. Selwyn, Director. Montreal, 1878. 8vo, pp. 515. Maps and illustrations. From the author.

Notes on the North American Caridea in the Museum of the Peabody Academy of Science, Salem, Mass. By J. S. Kingsley. (From the Proc. of the Academy of Natural Sciences of Philadelphia.) 8vo, pp. 19. From the author.

Entomological Notes. VI. By S. H. Scudder. (From the Proceedings of the Boston Society of Natural History, Vol. xix, 1877–78.) 8vo, pp. 51, 1 plate.

Smithsonian Contributions to Knowledge, 318. On the Remains of Later Pre-Historic Man, obtained from caves in the Catherina Archipelago, Alaska Territory, and especially from the caves of the Aleutian Islands. By W. H. Dall. Washington, 1878. 4to, pp. 40, 10 plates.

On Distomum crassicolle Rud.; with brief notes on Huxley's proposed Classification of Worms. (Memoirs read before the Boston Society of Natural History, February 21, 1877.) By Charles S. Minot. 4to, pp. 12, 1 plate.

On the Respiration of Amia. By Burt G. Wilder. (From the Proceedings of the American Association for the Advancement of Science, Nashville Meeting, August, 1877.) 8vo, pp. 8.

On the Annual Deposit of the Missouri river, during the Post-Pliocene. By J. E. Todd. (From the Proceedings of the American Association for the Advancement of Science, Vol. xxvi, August, 1877.) 8vo, pp. 5.

Jahres-Berichtdes Naturhistorischen Vereins von Wisconsin für das Jahr, 1877–78. Milwaukee, 1877. 8vo, pp. 17.

Brehm's Thierleben. Band. 4, Heft 1–3. Band 10, Heft 11. New York, B. Westermann & Co. 8vo, 40 cents a Heft.

Notice of the Discovery of the position of the Crural Processes in the genus Atrypa. By William Gurley. (Read before the American Philosophical Society, March, 1878). 8vo, pp. 2, 1 plate.

Cotton and the Principal Insects. etc., frequenting or injuring the Plant in the United States. Written and etched by Townend Glover. Washington, 1878. 4to, pp. 21, 22 plates.

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GENERAL NOTES.

BOTANY.

FERNS, IN THEIR HOMES AND OURS.[1]—We have often deplored the scarcity in this country, of popular handy books upon scientific topics. In England and on the continent, there is hardly a single department of natural science which has not, by means of low-priced manuals, received illustration at the hands of compe-

[1] Ferns in their Homes and Ours. By John Robinson. Salem, S. E. Cassino. 1878. 12mo, pp. 178.

tent men. Mr. John Robinson, long and very favorably known in New England as an amateur cultivator of ferns, an enthusiastic collector, and a pleasing teacher, has initiated a series which may supply the needed want. In the narrow limits of small pages and in an easy style, the author has brought before the reader a fund of information respecting ferns and their habits. There is little to criticise in the creditable accomplishment of this praiseworthy task. The volume is a timely contribution to a neglected portion of the field. Of late, we have been much favored by new books on Ferns: Prof. Eaton's Ferns of North America, Mr. Williamson's Ferns of Kentucky, Mr. Meehan's Native Flowers and Ferns, are all heartily welcomed. They admirably fill their several places, but are not one whit encroached upon by Mr. Robinson's Ferns. His work, in a manner, supplements all the rest.—*G. L. G.*

A Tree with two Stumps.—This would be nothing remarkable in the home of the banyan and mangrove, but in higher latitudes and especially in the dryer regions of the Mississippi valley it is strange enough to interest all observers.

Near Tabor, Fremont Co., Iowa, on the farm of Mr. John Rhodes, there stands a Bass-wood (*Tilia americana*), presenting the anomalous form of a vigorous trunk seventy-five feet high rising from two perfectly distinct stumps, about ten feet apart.

The stumps are of nearly equal size, and are narrower seen from the north-east. About six feet from the ground the cross section is fifteen by eighteen inches. The centers of the stumps are about ten feet apart at the surface of the ground. The timber has been cleared from around the tree so that it has attracted more attention recently, but Mr. Rhodes informs the writer that when he came into the country twenty-five years ago, the features of this tree were the same as at present, except that the whole was smaller. The upright stem was then only four or five inches in diameter. Two smaller trees connected with it have been cut down.

How may this strange growth be explained? The idea that it may have resulted from a seed sprouting upon a large log and sending roots down on both sides is forbidden by the height and breadth of the arched base. Logs of such size are not known in this country. It could not have been produced by any washing away of the soil, for it is on a nearly even and uniformly sloping hillside. The idea of its being formed by the growing together of two trees is extremely improbable, considering the angle at which the stumps unite. There seems but one other supposition possible, viz: that a young tree was in some way bent over till its top was rooted in the earth, while one of its branches embodied the upward vigor of the tree. This theory is strengthened by the fact that the eastern stump sends out more prominent roots, as

appears at the surface of the ground, also by the leaning of the lower part of the trunk toward the west.

What caused such a planting of the top of a tree in the ground can only be conjectured. It was done before any white man's axe felled a tree to crush it down. Perhaps some early trapper bent it down for a night's shelter, but more probably the wind overthrew the tree, which forced the young bass-wood to the ground and held it there. This case shows, as is not often seen, how the functions of the stem may be completely reversed, as in the western half of this arched base. It is the more interesting in every respect, because it is probably the work of natural forces unaided by man.—*J. E. Todd, Tabor College, May 2,* 1878.

Botanical News.—Messrs. Ivison, Blakeman, Taylor & Co., have issued Professor Gray's Synoptical Flora of North America. Vol. II. Part I. Gamopetalæ after Compositæ. It forms the first installment of the long expected continuation of Torrey & Gray's "Flora of North America."——Two parts have appeared of Meehan's "The Native Flowers and Ferns of the United States," the plates printed in colors by Prang & Co., Boston, from designs by A. Lunzer.——The *Bulletin* of the Torrey Botanical Club for June, contains notes on Vitis by Dr. Engelman; on *Botrychium simplex* in Massachusetts, by G. E. Davenport; Mr. Britton contributes a table of observations on the appearance of the leaves of shrubs and trees on Staten Island. A notice of Williamson's Ferns of Kentucky, speaks favorably of it as a convenient and excellent work.——The *Botanical Gazette* for June contains notes on the vitality of the seeds of *Datura tatula,* by T. C. Porter; on the plants of Indian Territory, by A. Wood; on polygamous flowers in Populus, by G. E. Davenport; on the distribution of certain plants in Missouri, by G. C. Broadhead (concluded in July number); and on Monotropa uniflora, by R. E. Kunze. The July number prints a letter from A. Fendler, on the botany of the Island of Trinidad. Mr. G. J. Lemmon contributes an amusing article on honorary names in scientific nomenclature. The same number contains advance descriptions of two new species of *Baptisia, B. calycosa* Canby, from St. Augustine, Fla., and *B. sulphurea* Engelmann, apparently from Missouri. The August number contains a list of the plants of Indian Territory, by G. D. Butler.——Among the articles in Trimen's *Journal of Botany* is a new key to the genera of Amaryllidaceæ, by J. G. Baker. An Arabis and a large Cincus were found growing, by F. V. Dickens, among the cinders almost at the summit of the volcano of Fusi in Japan, which is 12–13000 high. The number of visits paid during the year 1877, to the herbarium of the British Museum for scientific inquiry or research was 1297. Caruel's Vegetable Morphology is noticed as being fresh and original, with figures mostly original. At a meeting of the Linnæan

Society, April 4th, a paper was read by M. C. Cooke, on a collection of fungi, from Texas, collected by Mr. Ravenel some years ago; the series was small.——*Grevillea* for June contains Ravenel's American Fungi, including, the species issued in the first and second centuries of Ravenel's "American Fungi," with other species, collected at the same time, in insufficient quantities for distribution. Two elaborate monographs on the vine disease; one, published in Italy, by Pirotta, and the other in Austria, by Baron Thälmen, are noticed critically. A valuable article on the salmon disease, due to *Saprolegnia ferax*, which is common on the gold-fish, in aquaria, by W. G. Smith, is reprinted from the Gardener's Chronicle.——The last (20th) volume of Memoirs of the Société National des Sciences Naturelles de Cherbourg, only lately received, contains a life of the eminent botanist, Thuret, by Dr. E. Bornet, with researches on the development of buds in the Equisetaceæ or horse-tails, by E. de Janczewski, while the same author contributes notes on the development of the cystocarpe in the Florideæ, a contribution to the study of the mode of fecundation of the algæ. An essay of one hundred pages, on the industrial plants of Oceania, by Mr. H. Jouan possesses a good deal of practical interest.

ZOÖLOGY.[1]

Notes on a New Jersey Carpenter-bee.—A species of carpenter-bee (*Xylocopa virginica*) is very abundant in southern New Jersey, gnawing its tunnels most often in rails or fences, but frequently in parts of houses, so that it sometimes becomes a nuisance. As many as fifteen holes I once counted in a single rail, but these were the accumulation of years. The main part of the tunnel runs lengthwise with the grain. There are usually two, but sometimes three, branch tunnels, having a common opening.

I have often wondered how the insect, when fully developed, escapes from the nest in which it has undergone its transformations. Since the egg first laid is in the bottom cell, if the insect from this egg develops soonest it would have to gnaw its way out through the wood (as Reaumur states is the case with the French species *X. violacea*), or, scramble through the tunnel to the opening, to the dismay perhaps of the other bees. On examining a nest in January, 1877, containing five bees, fully formed, I found that the bee nearest the opening was of the darkest color—there being a regular gradation in color from this bee to the lightest colored one at the termination of the tunnel. I also noticed that the bees were in a similar position, back upwards and *head toward the opening*, and, although the partitions were destroyed, the raspings composing them lying on the lower side of the horizontal tunnel, the bees did not appear to have moved out of their original cell limits.

[1]The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

According to Reaumur, *Xylocopa violacea* so constructs its tunnel that the terminal cell ends very near the surface of the wood. This makes escape easy; but no such provision exists in any specimens of nests of *Xylocopa virginica* that I have examined, and I have never seen *but a single opening in nests from which the bees had escaped.* From the preceding facts it would appear probable that the insects escape from the original and only opening of the nest, and in order of position. I notice that there is a gradation in the length of the cells—the terminal or bottom cell being the shortest. The greatest number of bees I ever found in a nest was eleven. Woodpeckers seem to prey to some extent on the larvæ, or pupæ, as would appear from certain conical-jagged holes opening into successive cells. A specimen of such a nest may be seen in the Entomological Laboratory of Cornell University.—*Henry Turner.*

THE SKUNK EATEN BY THE LYNX.—Observing in a late number of the NATURALIST, the note "Food of the Skunk," reminds me that I have lately seen that the skunk is itself food for at least one animal. Dissecting a wild cat (*Lynx rufus*) two days since, I found bunches of woolly hair in the intestine. These had no perceptible odor. Upon opening the gullet, however, near the stomach I found a roll of skin and hair which at once announced its proper belongings by a stifling wave of the peculiar mephitic stench of the skunk. I did not look further, but contented myself with the reflection *de gustibus*, etc.

The lynx is said to feed upon rabbits, rats, squirrels and upon such birds as roost or breed on the ground, varying its diet from time to time with fish and frogs. The unusually mild winter through which we have passed and the absence of snow forbids the idea that hunger drove it to partake of skunk—besides which the lynx was very fat. The bunches of hair in the intestine may have been the remnants of some previous meal, or they may have been of the skunk but deodorized by bile. Perhaps strong alkalies may be found to destroy the odor of this stinking beast's secretion.—*B. W. Barton, M.D., 117 W. Madison Street, Baltimore, Md.*

CARNIVOROUS TADPOLES.—About thirty years ago Prof. S. F. Baird stated that the best method of cleaning the skeletons of small animals is to place them in a vessel of water containing living tadpoles of some of our common frogs. The tadpoles devour the macerated flesh with rapidity, leaving a ligamentous skeleton prepared with the greatest nicety. The species which Prof. Baird found most effective is the *Rana sylvatica*. This fact has been recently revived in some of the English scientific journals, and still more lately Miss S. P. Monks has made the same observation at Cold Spring, New York. Tadpoles are primarily, as the structure of the intestines indicates, vegetable feeders, but appropriate any organic matter in a state of maceration.

ANTHROPOLOGY.[1]

ANCIENT OLLA MANUFACTORY ON SANTA CATALINA ISLAND, CAL.—During my explorations along the Pacific coast I paid much attention to the discovery of the workshops of one of the most beautiful articles of true aboriginal workmanship. It is the *olla*, a cooking vessel made of a species of steatite, the pot stone, or *lapis ollaris* of old, of which Theophrastus and Pliny speak as a material used for the manufacture of vessels among the ancient eastern nations. My observations and notes, which I made while working on the mainland, pointed to the islands in the Santa Barbara channel as the locality in which the manufacture was carried on. I expressed the opinion in my report to the Smithsonian Institution (Hayden's Bulletin, Vol. iii, p. 50) that the site must be looked for on Santa Catalina island. During my last year's visit to that island, on behalf of the Peabody Museum, I discovered the first quarries in the locality called Pots valley. The pits and quarries revealed the busy hand of the aborigines, among the *débris*, and in the partly-covered pits where cooking vessels were found in all stages of finish, from the boulder but partly worked out from the rock and still firmly attached to it, the globular form roughly rounded, the boulder in which the excavation has already been commenced, and so on to the smoothly finished pot. All the implements with which the task was accomplished were also found, and by observing the progress of the work in the many specimens discovered, it was not difficult to ascertain the mode of manufacture, the result of which I made a subject of an essay accompanied by illustrations (Report of the Peabody Museum, 1877). Not only were cooking vessels extensively manufactured on this island, but also flat dishes (which the Mexicans call *Comáles*), cups, pipes, stone rings which were used as weights for digging-sticks, and all kinds of trinkets. These articles constituted the money of the people of Santa Catalina, like the shell-beads of the neighboring island of Santa Cruz, where they were extensively manufactured by the aborigines, and whence they were distributed far along the coast, and to some extent into the interior. The quarries are more abundant in number towards the south-eastern end of Santa Catalina where for about two miles square not less than three hundred quarries and pits were discovered during my last visit, with a large number of pot-boulders, sherds, tools, etc.—*Paul Schumacher.*

ABORIGINAL BURIAL.—A very singular case of aboriginal burial was brought to my notice recently by Mr. Wm. Klingbeil, of Philadelphia. On the New Jersey bank of the Delaware River, a short distance below Gloucester city, the skeleton of a man was found buried in a standing position in a high red sandy clay bluff

[1] Edited by Prof. ORIS T. MASON, Columbian College, Washington, D. C.

overlooking the stream. A few inches below the surface the neck bones were found, and below these the remainder of the skeleton, with the exception of the bones of the hands and feet. The skull being wanting, it could not be determined whether the remains were those of an Indian or of a white man, but in either case the sepulture was peculiarly aboriginal. A careful exhumation and critical examination by Mr. K. disclosed the fact that around the lower extremities of the body had been placed a number of large stones, which revealed traces of fire, in conjunction with charred wood, and the bones of the feet had undoubtedly been consumed. This fact makes it appear reasonably certain that the subject had been executed, probably as a prisoner of war. A pit had been dug, in which he was placed erect and a fire kindled around him. Then he had been *buried alive*, or, at least, if he did not survive the fiery ordeal, his body was imbedded in the earth, with the exception of his head, which was left protruding above the surface. As no traces of the cranium could be found, it seems probable that the head had either been burned or severed from the body and removed, or else left a prey to ravenous birds. The skeleton, which would have measured fully six feet in height, was undoubtedly that of a man. This forms an interesting example of the cruelty practiced by the aboriginal tribes on their prisoners. In the neighborhood of this grave many stone implements have been found and the remains of extensive Lenni Lenape encampments can be traced.—*E. A. Barber.*

Anthropological News.—Mr. A. F. Berlin, Reading, Pa., calls attention to polished arrow-points similar to those mentioned by Mr. J. D. McGuire in our last number. It may be that these so-called arrow-points were knives. Major Powell sent to the National Museum, three years ago, a collection of Pai-Ute flint knives glued in wooden handles, the blades of which would be taken for arrow-points. They are figured and described in Dr. Rau's work on the Archæological Collection of the U. S. National Museum, No. 287 of Contributions to Knowledge, page 2.

The circular issued by the Smithsonian Institution recently, calling for information relating to the permanent archæological remains of North America, has met with a hearty response from many quarters. Dr. G. S. B. Hempstead has prepared a revised chart of the Portsmouth Works at the mouth of the Ohio River, containing many more details than plate XXVII of Squier and Davis' work. Other enthusiastic archaeologists have promised to do the same for their respective counties. As the descriptions are received they are filed away in the name of the contributor, who will receive, in the summing up, credit for the work done.

Mr. Frank C. Cushing, the enthusiastic young assistant in the Ethnological Department of the National Museum, has recently visited an old soapstone quarry on the farm of Mr. John B.

Wiggins, near Chulu, Amelia County, Va. He not only succeeded in finding the localities where the ancient workmen had operated, but discovered in the neighborhood the quartz bed where they had obtained their implements for working the pot-stone. Mr. Cushing, to test their method, constructed a quartz pick and detached with it a mass of steatite. He made an accurate survey of the quarry and has reproduced in plaster a miniature model of it similar to the plaster representations of the cliff dwellings prepared by Mr. Jackson, of the Hayden Survey. A large number of pots, picks, mauls, tomahawks, &c., were also secured for the National Museum.

Mr. Edwin A. Barber, of West Chester, Pa., is collecting materials for a work upon pipes and smoking customs in all ages and nations. In order to make his work exhaustive he desires to know of every article ever written upon that subject. He also wishes sketches, photographs, cuts, electrotypes of aboriginal pipes, ancient and modern. Chewing and snuffing will come in for their share in the description. Inasmuch as we cannot get together often in our country, owing to the great distances, and talk over those matters which are interesting to all, the next best thing is to make the NATURALIST our medium of communication. We shall be glad to publish the name of any anthropologist who is working in a special field.

Dr. Theodor Poesche, of Washington, has published through Costenoble of Jena, a volume of 240 pages, entitled "Die Arier, Ein Beitrag zur Historischen Anthropologie." The author has collected a great deal of evidence to show that the theory of the Indian origin of the Arian races is untenable. The relationships existing between the various European races of that stock is traced and the author is inclined to believe them to be autochthonous so far as we know anything about them.

Part second of the *Revue d' Anthropologie* opens with a learned paper from the pen of Dr. Broca, upon cerebral nomenclature, including the names of the divisions and subdivisions of the hemispheres as well as their anfractuosities. Those of us who grew up in the notion that the human brain was a mass of convolutions, having no more order than the viscera or a dish of maccaroni, will be pleased to see what progress has been made in the investigations originated by Gratiolet, and since prosecuted by eminent anatomists, among whom M. Broca occupies a high rank. The object of this study is to localize and name the parts of the brain so that cerebral topography may become a useful part of anthropological study. The *Revue* always contains a large amount of useful matter edited by the most distinguished men in France under the titles: Revue Critique, Revue Préhistorique, Revue des Livres, Revue des Journaux, Extraits et Analyses, and Miscellanea. The Bulletin Bibliographique, a very valuable feature, is conducted by M. Dureau.

Parts ii., iii. and iv. of the Bulletins de la Société d'Anthropologie de Paris for 1877, come to us all at once. The operations of this society are so important that the entire contents of the numbers will be given, in the hope that some of our readers will light upon something for which they have been searching.

Part ii.—De la circoncision des filles [continued from Part i.]; Reprise de la discussion sur la religiosité; Rapport sur les archives du Musée national de Rio de Janeiro; De l'astigmatisme visuel; de la prostitution et ses rapports avec la dépopulation; Corses et Albanais, Types bulgares; Des dialectes berrichons; Sur la technique microskopique dans ses applications a l'etude de la chevelure dans les races humaines; Sur les mariages consanguins; Sur la fécondité des prostituées; Sur la cerveau a l'etat fœtal; Sur la montagne de l'Espiant; Caverne de Cravanche-Belfort; Topographie cérebrale comparée de l'homme et du cynocéphale; De la génealogie de l'homme d'apres Haeckel; Squelette humain a onze paires de côtes; Gravure et sculpture des os avec le silex; Amulettes des grottes de Menton.

Part iii.—Continuation of Gravure et sculpture, &c.; Sur une amulette en schiste talqueux de Menton; Sur les découvertes de la baie de Penhouet; Sur l'origine des Oromo et la durée d'une generation; Sur l'angle orbito-occipital; Sur le tatouage par incision et torsion de la peau; Sur les crânes Savoyards; Sur les origines de fer; Sur la langue vei et la race Kruman; Sur un cas d'hémitérie héréditaire; Sur le Grand Chaco; De la trépanation du crâne sur un chien vivant; Sur une statistique des Apophyses styloïdes vertébrales chez l'homme; De la plagiocephalie chez le singe; Transformation de l'oreille chez les vertebrés, Responsibilité des sourds-muets; Crâne tartare, Pli transversale de la main du singe chez l'homme; Sur un cerveau de gorille, Sur la statistique des naissances gémellaires et leur rapport avec la taille.

Part iv.—Sur le cerveau de gorille; Fouilles en Andalousie; Mensuration chez les conscrits; Indiens de Paya; Deformation syphilitique du crâne; Croyance à l'immortalité de l'âme; De la vue humaine; Sur les Celtes; L'espèce humaine; Type de l'enfant dans l'art et dans la science; Textes relatifs aux Celtes; Collection préhistorique de Budapest; Les Penongs Piâtes; Maladie des Scythes; Fouilles de Caucase; Perforations crâniennes du Perou; Explorations dans le Sahara; Crânes d'anciens cimetières; Rapport sur les Esquimaux du Jardin d'Acclimatation; Les Esquimaux d' Asie; Recherches craniométriques; Anciens peuples de l' Europe Centrale; Questionnaire sur le Grœnland; Synostoses crâniennes; Nomenclature cérebrale; Des apophyses styloïdes lombaires; Composition du lait de la femme Esquimau; Momies du Haut Pérou; L'ambre préhistorique; Groupe de Lapons obsérves à Londres; Circonvolution limbique.

GEOLOGY AND PALÆONTOLOGY.

THE VERTEBRÆ OF RACHITOMUS.—This genus of Labyrinthodonts was characterized in this journal for May, 1878 (p. 328)[1], from vertebræ. Since that date, the reception of other specimens enables me to add some points to the definition already given.

There is an element representative of the centrum wedged in between the superior external angles of adjacent intercentra, as in *Trimerorhachis*. These, as well as the intercentra, differ from those of that genus in their greater degree of ossification, which is so far complete as to greatly contract the *canalis cordæ dorsalis*. The central elements of opposite sides do not unite on the middle line, although in contact. The neurapophysis is produced downwards and outwards, terminating in the simple diapophysis, with rib articulation. The inferior articular faces of the arch are two on each side, one for the central element in front, and the other for the one behind it. The whole is surmounted by a continuous neural spine, which is expanded at the summit in the known species. The ilium is a subspatulate flat bone, with its rather thin oval proximal extremity directed backwards, and extending across three centra.

It is probable that the vertebræ of the genus *Eryops* (Pr. A. P. S. 1878, 520), and perhaps those of all the true *Labyrinthodontia*, are constituted as in *Rhachitomus*.—*E. D. Cope*.

THE POSITION OF DIPTERUS.—Dr. R. H. Traquair has recently studied the structure of *Dipterus* and has determined several points which are essential to a knowledge of its systematic position. He finds that in its suspensorial apparatus it agrees with *Ceratodus* as well as in its palopterygoid bones. He infers that the character of the pectoral fins is identical with that of *Ceratodus*. The skull differs from that of the genus in question in the greater degree of ossification of all its parts. Dr. Traquair places *Dipterus* definitely among the *Dipnoi*, as already done inferentially by Günther. He also regards *Paladaphus* as a member of the same sub-class; and discovers that *Chirodus* is based on the splenial tooth of a *Platysomid* fish.

A FOSSIL WALRUS DISCOVERED AT PORTLAND, MAINE.—The larger part of the skeleton of a walrus, including the skull with tusks over five inches long, and all but two of the teeth, has lately been unearthed from the Quaternary Clays of Portland, Maine. It was partially imbedded in a layer of blue clay a foot in thickness, overlaid by a layer of lighter clay two feet two inches thick, containing casts and shells of *Mya arenaria*, *Macoma subulosa*, *Mytilus edulis*, *Cardium* (*Serripes*) *grænlandicum*, *Astarte striata*, *Saxicava distorta*, *Nucula antiqua*, *Leda tenuisulcata*, *L. truncata*, *Natica clausa*, and *pusilla*, and *Balanus*. The skeleton is in the museum of the Portland Society of Natural History.

[1] See Proc. Amer. Philos. Soc., 1878, p. 526.

GEOGRAPHY AND TRAVELS.[1]

THE AMAZON.—The U. S. corvette *Enterprise*, Commander Thomas O. Selfridge, arrived off Para, Brazil, on the 24th of May, having been ordered to make a survey of the Amazon river as far as Manaos, and the Madeira as far as San Antonio. From a correspondent of the *New York Herald* we learn that the Enterprise started up the river on the 3d of June. Passing the mouth of the Tocantins she entered the first narrow canal. These natural canals or *furos* resemble the artificial channel made by Capt. Eads at the mouth of the Mississippi—the heavy growth of aquatic plants and the thick interlacing of the roots of the trees forming in these narrow passages barriers similar to the mattresses used by him. A frigate may pass through these natural jetties of the Amazon without fear, for the rush of water keeps the way clear.

Two serious accidents to the machinery caused considerable delay, but the survey had been conducted successfully at the rate of about sixty miles a day up to the date of this letter, on June 15th, off Serpa, thirty miles below the mouth of the Madeira. No triangulation is undertaken, but simply a track chart is to be made. The points noted are the depths, the profile of the shore, the position of the islands, the courses steered, the bearings of prominent points, the fixings of landmarks, the strength of the current, the character of the banks, the compass deviations, the meteorological changes, the barometric altitudes and the latitude and longitude of the towns, villages, bars, shoals and rocks of the river.

A correspondent of the *New York World* gives an interesting account of the Island of Marajò, the largest in South America, at the mouth of the Amazon. Its area is nearly that of the State of New York. This immense tract, formed by alluvial deposits, is a vast plain, without hill or valley or springs of water. The island is divided diagonally into two sections nearly equal in extent, the south-western being covered by forest, and the north-western being an extensive prairie with occasional groups of trees. The former section is of great fertility and yields a great variety of valuable timber, medicinal plants and a great number of India rubber trees (*Syphonia elastica*). The prairie is devoted to cattle raising, and their number is estimated at 250,000. In many places the land is below the level of the river bed, and during the rainy season these tracts are almost entirely submerged, and overflowing fill the lakes and rivers of the island, of which Lake Arary and the river of the same name are the most important. With the exception of some plantations of sugar cane and cocoa, the raising of cattle on the prairies, and the manufacture of the India rubber in the forest region are the only industries of this extensive territory. The population is supposed to be about 36,000.

[1] Edited by ELLIS H. YARNALL, Philadelphia.

Fluvial Intersections of Mountain Ranges.—In an article upon the Himalayan System, included in the Proceedings of the Berlin Geographical Society, Herr Von Richthofen remarks (as translated in the July *Geographical Magazine*): In the history of orography three styles may be distinguished. As hydrography generally precedes topography, so water-partings come to be hypothetically regarded as mountain ranges; those between the principal rivers being considered as ranges of the first degree, and those between minor streams as ranges of lower degree. By the knowledge of the elevations and depressions of a country we arrive at the second stage and find that the mountain ranges do not always coincide with the water-partings. Some of the ranges are found to be intersected by rivers and the most general features of the structure become apparent. A third stage is reached when we have obtained from the geological composition not only a scientific knowledge of the main features of the formation, but also understand the laws of the arrangement of the secondary features. The transition from the first to the second stage can be seen most distinctly in those mountain systems which have only in our own time become known, as, for instance, in the one of the Tian-Shan and the Pamir Mountains, where in the unexplored districts, the water-parting system still regulates the drawing of our maps; whilst, in all districts which have been surveyed more accurately, range after range appears distinctly with frequent fluvial intersections.

A continuous function of water-parting is not the necessary mark of a mountain range. In the case of the Himalayas the principle adopted long ago from a purely geographical point of view by geologists, but rarely admitted by geographers, is triumphantly established, *i. e.*, that mountain ranges are to be considered independently of interruptions and intersections by river valleys and that the latter are only to be regarded as solutions of continuity of a secondary importance.

Geographical News.—The U. S. Coast Survey steamer *Blake* returned about the 1st of July, from dredging operations in the Gulf of Mexico. Capt. Patterson of the Coast Survey, states that the extensive and accurate soundings of the Gulf, taken by the improved scientific methods on this voyage, do not tend to confirm the belief, long held, that the equatorial current, after rushing from the Caribbean Sea through the channel formed by the West Indian islands and the northward projection of Yucatan makes the whole tortuous circle of the Gulf close by the shores of Central America, Mexico and the southern coast of the United States, before emerging into the Atlantic, between the point of Florida and the Bahamas. The observations tend rather to prove that the force of the incoming equatorial stream extends itself in one direction against the mass of the Gulf long before it reaches the Texas coast and then turns directly towards and re-issues into

the ocean.——Col. Prejevalsky, an account of whose last journey to the Lob-Nor was given in the NATURALIST for August, writes from St. Petersburg (London *Academy*, June 29th), that he is obliged, on account of his health, to take a complete rest until December next, when he expects to start for Port Zaizan, whence he will depart for Hami and Sha-chan, en route for Tibet. Upon his return, probably at the end of 1880, he will set to work on the materials he has collected.

Dr. Behm, in his *Monatsbericht* (July *Mittheilungen*), states that included in his collections is the skin of a species of wild horse named Tarpan, which dwells in the sandy deserts of Dsungaria, together with (*neben*) the Kulan (*Asinus kiang*) and the Djigetai (*Asinus hemionus*). This specimen was slain by the Kirgise at Gutchen.——The London *Athenæum* is informed that the recent telegraphic determinations of longitude executed by the Indian Survey Department have resulted in the geodetical connection of Madras Observatory, the pivot on which the whole fabric of Indian triangulation rests, with Aden and Suez, and hence with Greenwich. The result of this measurement is to establish a new value for Madras Observatory (80° 14′ 51″ E. of Greenwich), which will thus affect all Indian meridians and which will have, theoretically, the effect of moving India 2000 feet or so further from England. It is hoped to establish further geodetical connection with Australia, and ultimately that San Francisco on the one side, and the Russian stations on the Pacific on the other, may be brought into connection with Europe.——Dr. Van der Horck, who delivered an address before the American Geographical Society, in 1876, on the results of an expedition made by him to Lapland, 1874-5, has now gone to Hong Kong on a mission entrusted to him by the German government and the Berlin Geographical Society. He is to organize an expedition to traverse the whole of the Eastern Asiatic coast, the islands especially; then crossing at Behring's Straits to follow down the western coast of America to Oregon. The objects of his journey are scientific investigations, coast surveys, deep sea dredgings, geological, zoölogical and botanical researches, and, above all, anthropological studies concerning the migration of men from Asia to America, and to see if remains of an ancient migratory people cannot be found on the isolated groups of islands of these regions. The means at the disposal of the expedition will be liberal, and the time unlimited, and it is expected that the work of the expedition will consume three or four years. (*New York Tribune*).——Last week we spoke of the generosity of the United States Government in the distribution of the publication of their admirable surveys. We regret to see, from a speech in the House of Representatives by the Hon. O. R. Singleton, that the usefulness of Dr. Hayden's surveys threatens to be seriously crippled from want of funds. The appropriation for this survey in 1867, was

only $5,000, which in 1873 had been raised to $95,000. In 1876 this was reduced by $30,000, and again, in 1877, by $20,000, leaving the appropriation at only $45,000. The largest sum is what is actually needed that the survey may be carried on with efficiency, and to reduce it is quite unworthy of a nation so advanced and liberal as the United States, and is really the worst possible economy. The additions which have been made to science by Dr. Hayden's survey have been immense and of the highest importance, and its economic value to the country can be no less great. The mere list of the many admirable publications of the survey is sufficient to prove that the money has been well spent; and we trust that the United States Government and Congress will be able to rise above all party feeling, and prove to the world that they have the best interests of the country and the interests of scientific knowledge at heart by restoring the appropriation to at least its old amount. Mr. Singleton truly says that not a small item in favor of these surveys is the check they place on mining and land swindles.—*Nature.*

OBITUARY.—Admiral Sir George Back, F.R.S., deceased on the 23d of June, aged eighty-one years. He took part in five Arctic expeditions, the most important of which were the "Franklin Second Expedition," in 1825–27, "The Arctic Land Expedition to the mouth of the Great Fish river and along the shores of the Arctic ocean," in 1833–35, and "The Expedition of H.M.S. *Terror*" in 1836–37.

John A. MacGahan died at Constantinople, the 9th of June, aged thirty-two years. He will hereafter, be remembered for his wonderful journey to Khiva, in 1873, as related in his admirable work, "Campaigning on the Oxus." He also wrote an account, "Under the Northern Lights," of his voyage on the *Pandora*, with Capt. Allen Young, up the Peel strait, in 1875.

Mr. T. T. Cooper, British resident at Bhamo was assassinated at that place on the 13th of May. He was forty-one years of age, and was the author of "Travels by a Pioneer of Commerce," in which he related the details of a remarkable journey from Shanghai, through China and the border county of Tibet, to Yunnan.

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SCIENTIFIC NEWS.

— The sixth volume of the Proceedings of the California Academy of Sciences for 1875, has just been received, and contains a variety of interesting papers on the geology, insects, shells and plants of the Pacific slope. Part I, Vol. vii, just published, forms a *brochure* of 174 pages, and contains a number of papers on Pacific coast Lepidoptera, by Mr. Henry Edwards, two articles on Crustacea, by Mr. W. G. W. Harford, and numerous

papers on the same subject by Mr. W. N. Lockington, as well as botanical notes and articles by Dr. A. Kellogg. A new mollusc (*Paludinella newcombiana*) is described by Mr. H. Hemphill, while Dr. A. Stuxberg makes a preliminary report on the Lithobii of North America. The Academy is now one of the most active societies in the country, and rapidly developing the physical features, natural history and anthropology of the Pacific States.

— *Forest and Stream* reports the discovery of *Amphioxus lanceolatus*, by Mr. H. J. Rice, off old Point Comfort, Va. We look for its discovery on the southern coast of New England, as it occurs on the southern coast of Norway. A specimen of the skua, or *Stercorarius skua*, was captured early in July on the George's Bank by a fisherman. The cunner (*Tautogolabrus*) has been hatched artificially at Bucksport, Maine, by Mr. C. G. Atkins. The U. S. Fish Commission have obtained through the Gloucester fishermen *Chimæra plumbea* Gill., caught on a trawl line at a depth of 275 fathoms, near Sable island; also the third specimen in existence in museums of the gredadier, or *Macrurus rupestris* Bloch. Corals of the genera *Mopsea* and *Isis* were also brought in by fishermen from the banks.

— The anniversary address of Prof. Martin Duncan, the President of the Geological Society of London, is an interesting *résumé* of the most important results of recent palæontological discoveries, with especial reference to the fossil mammalian fauna of Gibraltar, Malta and North America, the relative hypothetical position of lands in the Tertiary period, particularly in Africa and South America, as well as to recent advances in the study of fossil sponges, Echini, and the Carboniferous fauna of the Southern Hemisphere.

— The late Col. Stephen S. Olney, of Providence, well known for his zeal in the study of botany, has bequeathed an indefinite but probably large sum to Asa Gray, of Cambridge, Mass., and William M. Canby, of Wilmington, Del., in trust, to be applied in such a manner as, in their judgment, will best and most promote the study, advancement and progress of the science of botany in the State of Rhode Island.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Appalachian Mountain Club.—Sixth Field Meeting, North Conway (Rev. Mr. Worcester's Study), N. H., Wednesday, Aug. 21, 1878. Several interesting papers were read by Profs. Pickering and Hitchcock, Rev. Messrs. Worcester and H. A. Parker, the two latter upon topics especially appropriate to the place. Excursions were arranged for Mts. Moat, Chocorua, Carrigain and Willey, and through the Notch.

The following extracts convey an idea of the summer work of 1878:

Natural History.—Members of the Club are requested to carefully observe and record any facts, features, or phenomena interesting to them, which are connected with the Botany, Zoölogy, Geology, or Meteorology of any mountainous region. Opportunity will be given at sectional meetings for the presentation and discussion of such items, with the hope that interesting facts may be gathered and collated.

For good general directions, the report of the first Councillor in this department, Dr. T. Sterry Hunt, published in Appalachia, No. 1, is heartily recommended. Those interested in Botany are requested to use Mann's Lists and Catalogue, which may be obtained from the Secretary.

Any reports, communications, inquiries, or specimens designed for use in this department of the Club, may be sent to the Councillor, William H. Niles, Councillor of Natural History, Cambridge, Mass.

Topography.—1. If inclined to do any work with plane-table, camera, micrometer-level, barometer, or theodolite, communicate with the department concerning instruments and methods. State for how long a time the instrument is desired. It is expected that members will keep constantly in use the new topographical camera presented to the Club by one of our lady members.

2. Signify willingness to aid, in the event of making a systematic occupation of Moat, Osceola, Willey, Agassiz, or some point in the north-east.

3. One unprovided with special instruments can accumulate much valuable material.

Note the qualifications of a point to serve as a station of the triangulation.

Having roughly copied (on a large scale) those points in a certain region which are shown on any map at hand, sketch in additional details. Make the map a complete memorandum in regard to one or more classes of objects, such as summits, cols, springs, pools, streams, water-shed lines, roads, buildings.

Make eye-profiles, with identifications and conjectures. These are valuable whether the point be occupied with the camera or not. With the aid of a glass make eye-profiles, on a very large scale, of interesting details. When a camera profile has already been drawn, visit the spot with a copy made in uniformly light lines, and retouch the lines, giving them proper relative importance. Also make additional identifications.

Set signals, with due provision for finding the exact spot in case the signal be overthrown. Pole must be vertical. Erect trees may be used by cutting away the lower branches and sym-

metrically trimming the top. Notify the department, with full particulars, as soon as a signal is set.

4. Communicate by mail with the Councillor, concerning special work desired in any vicinity, giving information, where able, as well as making inquiries. If unaware of his immediate location among the mountains, address him at 46 Federal street, Boston, Mass. J. Rayner Edmands, Councillor of Topography.

Art.—The department of art invites from members of the Club who are interested in this direction, notices of the finest views observed during the summer, with discussions of the elements of beauty conspicuous in them; also lists of photographs of peculiar excellence, and descriptions of interesting pictures. It is desirable that a record of the ownership of such pictures be kept, for the sake of future exhibitions.

The department also solicits correspondence from the members of the Art Section relative to the work of the Section.

Address, after July 1st, North Conway, N. H. John Worcester, Councillor of Art.

Exploration—While we have a general knowledge of the Appalachian region, and know something of its topography, geology and natural history, there are large areas of which we have no specific knowledge. To make observations and collect facts of scientific interest in any part of the region where no scientific man has ever been comes legitimately within the scope of Exploration. For suggestions in the matter of exploration, the attention of the members of the Club is called especially to Appalachia, No. 1, p. 49; No. 2, p. 117; No. 3, p. 189; No. 4, p. 282. In the last, reference is made to a circular which has been prepared for the purpose of recording observations. Those who expect to visit any mountain during the summer are requested to obtain copies of this circular from the Secretary.

Members of the Club have already signified their intention of making explorations in the Adirondacks, the valley of the East Branch of the Pemigewasset, the region of Mount Katahdin, and other interesting localities.

Any member of the Club who intends making explorations in a region new to them, and wishes information as to what is already known of the region and the points that seem especially desirable to study, will have such questions answered as far as the Councillor of Exploration is able to give the desired information. Address Box 1914, Boston, Mass. J. H. Huntington, Councillor of Exploration.

Improvements.—The following work is proposed:

1. Completion of indications of path by rock signals, one white rock surmounting a triangular base of three rocks of any color, above the timber line on the Mt. Adams path and its branches.

2. Finish cutting the Carter Notch and Carter Dome path.

3. Cut a path up Mt. Willey, along the north bank of the brook about 400 metres (1-4 mile) south of Moore's Brook flag station on the P. & O. R. R.

4. Cut a path around Frankenstein Cliffs, following up Bemis Brook to Arethusa Falls, crossing to the falls above Ripley's on Cow Brook, and descending along the latter brook.

5. Cut a path from the Ponds, near Greeley's, Waterville, through to Sawyer's River R. R., Upper Bartlett, with a branch up Mt. Carrigain.

6. Cut a path to the top of Moosilauke from Woodstock, following up the Moosilauke River.

7. Measure and mark, metrically, the new Moat Mt. path.

8. Construct a camp in King's Ravine, as near the Head Wall, as water may always be found.

9. Construct a camp on the Mt. Carrigain branch path, as far up as water may always be found.

10. Mark meridian lines pointing to true north, in White Mt. region about 13° E. of magnetic north.

It is expected that a party, with headquarters at the Mt. Crawford House, will be at work on Mt. Willey and around Frankenstein Cliffs, between July 4th and 10th, and Appalachians interested are invited to assist.

The Councillor may be addressed at Weymouth, Mass. W. G. Nowell, Councillor of Improvements.

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SCIENTIFIC SERIALS.

Bulletin of Hayden's U. S. Geological and Geographical Survey of the Territories.—No. 3, Vol. IV. July 29th, 1878. Field-notes on Birds observed in Dakota and Montana along the Forty-ninth Parallel, during the seasons of 1873 and 1874, by Dr. Elliott Coues, U. S. A., late Surgeon and Naturalist U. S. Northern Boundary Commission. Notes on a Collection of Fishes from the Rio Grande, at Brownsville, Texas, continued, by D. S. Jordan, M.D. Preliminary Studies on the North American Pyralidæ, 1, by A. R. Grote. Palæontological Papers, No. 6. Descriptions of New Species of Invertebrate Fossils from the Laramie Group, by C. A. White, M.D. Palæontological Papers, No. 7. On the Distribution of Molluscan Species in the Laramie Group, by C. A. White, M.D. On some dark Shale recently discovered below the Devonian Limestones at Independence, Iowa, with a notice of its Fossils and description of new species, by S. Calvin, Professor of Geology, State University of Iowa. On the Mineralogy of Nevada, by W. J. Hoffman, M.D.

THE QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.—July. Mr. C. O. Whitman, of Boston, contributes an elaborate and lengthy essay on the embryology of Clepsine, a leech-like worm. The article is one of the most important contributions in this difficult field of research. It treats of the origin and growth of the egg, its impregnation and mode of deposition, of the changes preliminary to and during cleavage, of the gastrula and "neurula" stages, comprising the growth of the germ-layer and the concomitant invagination of the pharyngeal clefts, of the origin of the nerve-chain, segment cells, segmental organs and segments, of the origin and development of the alimentary canal and circulatory apparatus. The author believes that the "neurula" of the chick, or of the fish, belongs to the same type as that of Clepsine, and the concluding remarks on the identity of type, in this phase, of worms and vertebrates, are of a good deal of interest. The researches were made in Prof. Leuckart's laboratory.

BULLETIN OF THE AMERICAN GEOGRAPHICAL SOCIETY.—No. 2. 1878. Japan: Geographical and Social, by Rev. W. E. Griffis. The So-called Celtic Monuments of Brittany, France, by W. Wright Hawkes, LL.D. Recent Journey of Exploration across the Continent of Australia; its Deserts, Native Races and Natural History, by Mr. Jess. Young, F.R.G.S., F.R.A.S.

THE GEOGRAPHICAL MAGAZINE.—July. The Vilayet of the Islands of the White Sea (with a map showing the administrative divisions). The Country of the White Horde of Kipchak, by H. H. Howorth. Origin of the Ordnance Trigonometrical Survey, by S. Mossman. The Marine Survey of India, 1876–77.

THE AMERICAN JOURNAL OF SCIENCE AND ARTS.—August. Forest Geography and Archæology, by A. Gray. Structure and Origin of Mountains, by J. LeConte. Occurrence of a solid hydrocarbon in the eruptive rocks of New Jersey, by I. C. Russell.

POPULAR SCIENCE REVIEW.—July. Volvox globator, by A. W. Bennett. The Extinct British Wolf, by J. E. Hasting. On the Radiolaria as an Order of the Protozoa, by G. C. Wallich. How were the Eocenes of England deposited? by J. S. Gardner.

THE GEOLOGICAL MAGAZINE.—July. On the possibility of changes in the latitudes of places on the earth's surface, by O. Fisher.

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HOW THISTLES SPIN.

BY PROF. W. J. BEAL.

A HASTY glance at a plant of *Cirsium altissimum*, a very tall thistle, shows that the main stem, its branches, the midrib and prominent veins of the leaf are clothed with soft slender hairs. The entire under surface of the leaf is white or gray with a dense coat of cotton. The scales of the spiny-tipped involucre appear as if they were tied together by numerous gossamer threads. If the young leaves and buds are pulled apart many fine threads spin out an inch or more until the parts are separated far enough to break the threads.

Under a magnifying power of one hundred diameters, the larger hairs, an eighth of an inch in length, are seen to be composed of a row of about fifteen cells placed end to end. The largest hairs are found on the stems and midribs.

At the top of the jointed hairs is a long lash, sometimes an inch in length which generally extends towards the tip of the leaf or stem. These hairs are very numerous, and stick more or less to each other. Fig. 1 is a good representation of one of these hairs while young, before it has been drawn out at the extremity. Fig. 2 represents a similar hair more highly magnified. In the latter case some of the cells have been used up to form the thread-like lash at the extremity.

FIG. 1

Young hair on stem of *Cirsium altissimum*.

FIG. 2

Older hair with part of thread.

In Fig. 1 the hair appears not to have acquired its growth. Near the base the cells are still very short, and not as they appear at the base of figure two. Some of the upper cells are slightly darker, and are filled with a yellowish-white mucilage. When young, the extreme cells are long, smooth and tapering. At that time they lie flat on each other, and are sticky and adhere to the tips of the hairs which they overlap. As the leaf or stem grows in length, the hair-stalks straighten up, and from the tip of each a thread is drawn out. In this process some of the cells are exhausted and used up in the thread.

When the flower-bud is an eighth of an inch in diameter and one of the surrounding scales the twentieth of an inch in width, some of the hairs on the margin of the scale appear like Fig. 3,

FIG. 3

Margin of young scale of involucre.

where one short cell is tipped with another—long and slender. These tips are sticky and may be easily drawn out. As the buds expand, the tips of these hairs are caught and drawn to the right or left by the scales next to them. When full grown the heads look as though a spider had spun webs round and round the outside. At this time the hairs appear like Figs. 4 and 5, where there is a long lash with one or two or rarely more cells at the base. Fig. 6 shows the edge of a scale of the involucre with one of

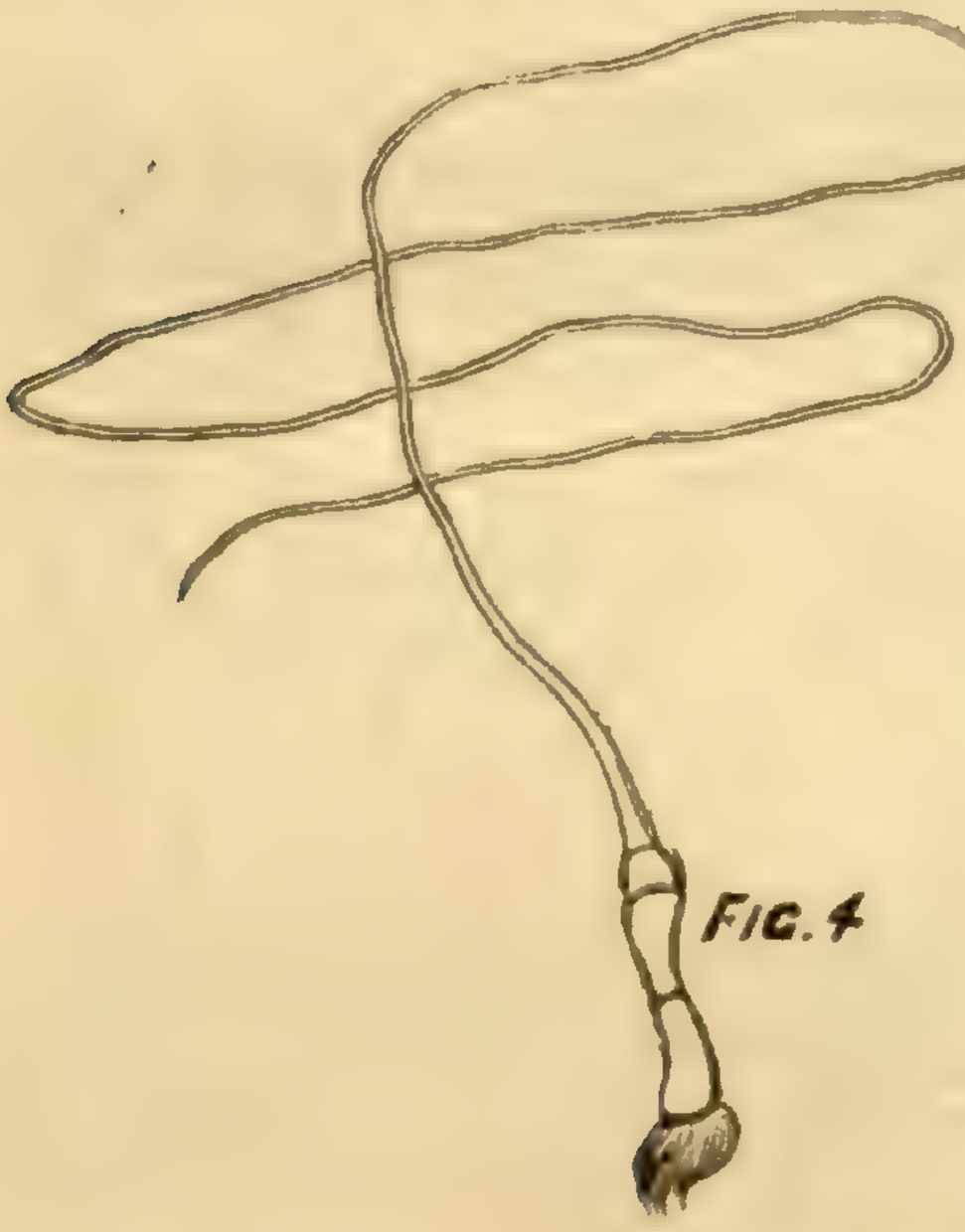

FIG. 4

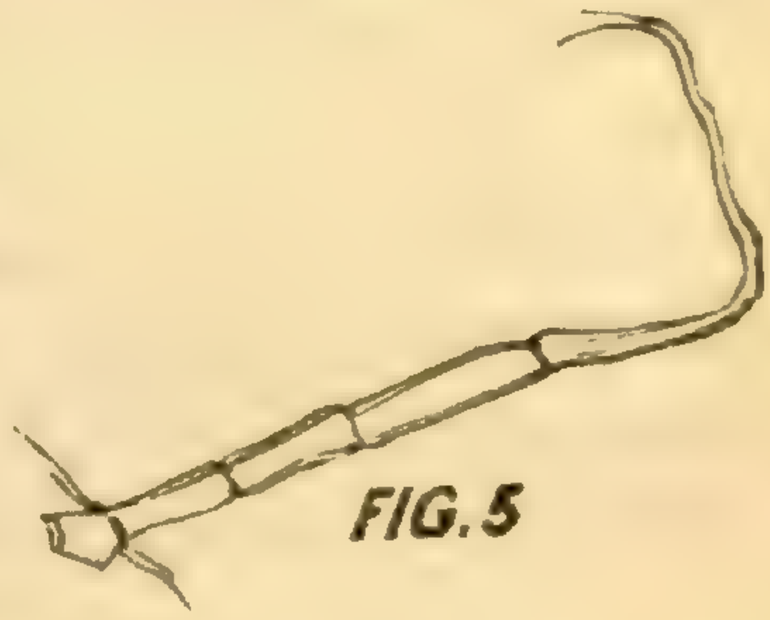

FIG. 5

Hairs on the back of a full-grown leaf.

these hairs, the part of another, and a couple of short prickles.

The webby layer of white or gray on the under side of the leaf is composed of cells similar to those last mentioned. They appear to grow in a similar manner. As the young leaf spreads and elongates, each hair draws out a thread which helps to cover the under surface with a dense web. This web adheres quite closely and firmly to the surface of the leaf.

The leaves of several other plants, like the Concord grape, Centaurias, etc., are covered in a manner similar to the leaf of the thistle. The branching hairs of the mullein and leaves of button-wood, when very young, are like those of the thistle, only the extremities are not sticky.

In the New Testament we read, "Consider the lilies of the field, how they grow: they toil not, neither do they spin." This was not said of thistles nor of grape vines.

The thread of the thistle is single and slowly drawn out. Perhaps it may be called a clumsy affair when compared to the delicate cable of the spider, with its numerous strands. The thread of the thistle answers well enough the purposes for which it is intended. It protects the plant from sudden changes of weather, keeps the rain from wetting the surface, and probably to some extent keeps enemies from injuring the plant.

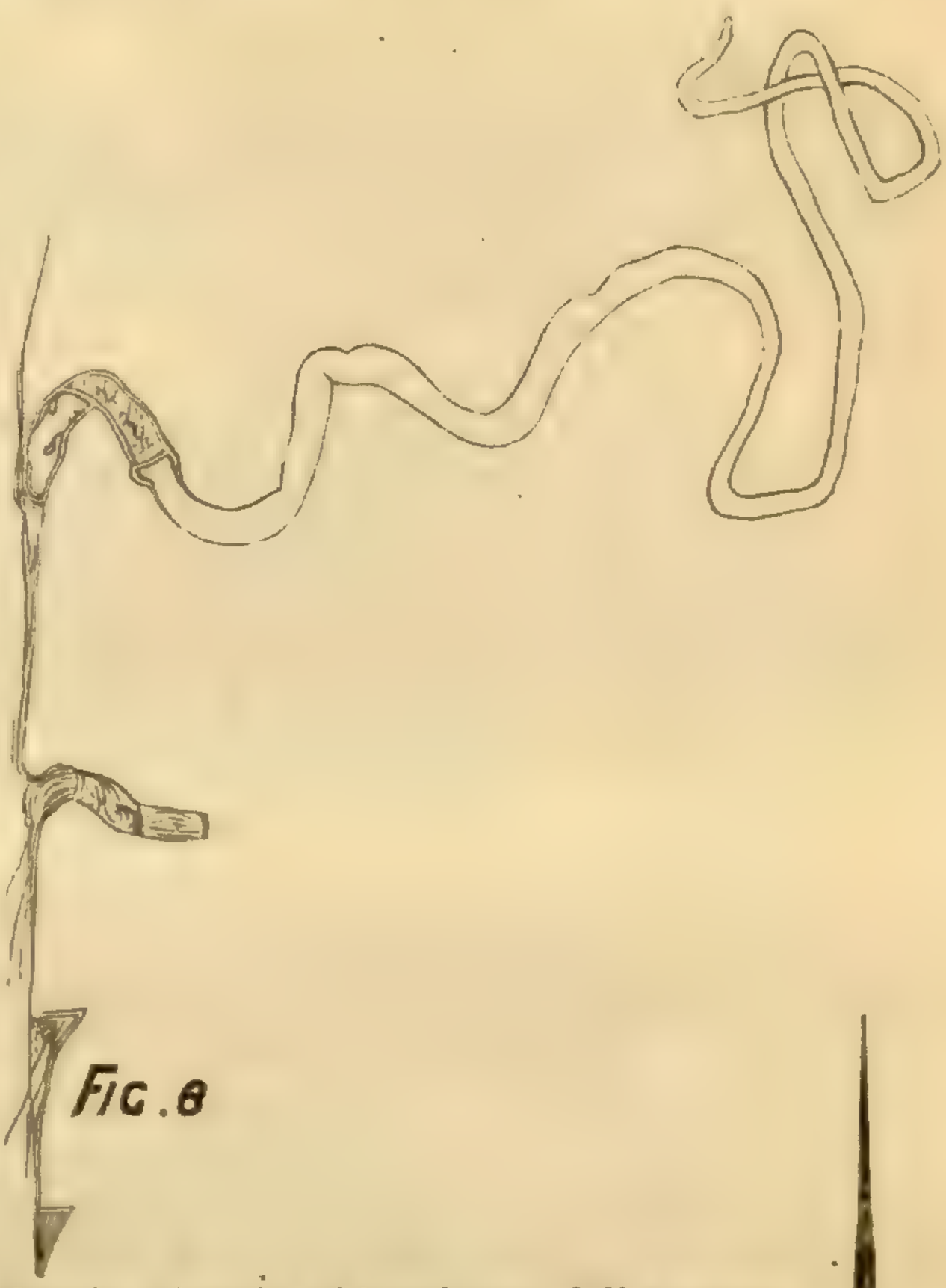

FIG. 8

Margin of scale of involucre, full grown.

FIG. 7

Scale of *C. altissimum*, showing gland at *a*.

There is one other fact of interest about the thistle under consideration. When full-grown the scales about the heads of flowers have each an oblong gland just at the apex where the spine starts up. Fig. 7 shows this gland. The object of the gland I am as yet unable to determine. It may and probably does attract insects. It often entraps them. I have many times seen six to ten small flies and *Hymenoptera*, some of them half an inch in length, held fast by mouth or legs or wings. Here they buzz and twist and pull till strength and life are exhausted. Whether this is of any use to the plant for food or amusement, to keep away larger insects, or to attract spiders or ants, I have not yet ascertained.

PLANTS USED BY THE INDIANS OF THE UNITED STATES.

BY DR. EDWARD PALMER.

[*Concluded.*]

Textile Plants.—Yucca baccata. This is one of the most useful plants to the Indians of New Mexico, Arizona, and Southern California. Its fruit is eaten while fresh and in the dry state. It grows from two to eighteen feet in height, and becomes a tall tree further southward, varying in diameter from eight to twenty inches. The bodies of these plants are very fibrous. The Indians and Mexicans when in want of soap cut the stems into slices, beat them into a pulp, and mix them with the water in washing as a substitute for soap, for which it answers finely. The leaves are generally about two feet in length and are very fibrous. In order to remove the bast the leaves are first soaked in water, then pounded with a wooden mallet, at the same time occasionally plunged into water to remove the liberated epidermis. Then if not sufficiently clean and white it is returned to the water for a time and again put through the beating process; generally the second course is sufficient. The fibres of the leaves being strong, long and durable are adapted for Indian manufactures, and the savages of Southern California make therefrom excellent horse blankets.

All the tribes living in the country where this plant is found, use it to make ropes, twine, nets, hats, hair brushes, shoes, and mattresses.

The Diegeno Indians of Southern California have brought the uses of this plant to notice by the various articles they make from its fibres, and sell to white settlers. In preparing a warp for the manufacture of saddle blankets, it is first loosely twisted, then when wanted it receives a firmer twist. If the blanket is to be ornamented, a part of the warp during the first process, is dyed a claret brown, oak bark being used for that purpose. The loom in use among the Indians of to-day is original with themselves, and not borrowed, as some suppose, from the Spaniards. It is a simple affair consisting of two round, strong, short poles, one suspended and the other fastened to the ground. Upon these is arranged the warp. Two long wooden needles with eyes are threaded with the filling which is more loosely twisted than the warp, in order to give substance or body to the blanket. Each time that the filling is thrust between the threads of the warp by

one hand, the Indian female with a long, wide, wooden implement in the other hand, beats it into place. This tool resembles a carving-knife, but is much larger and longer. One edge is thin, and in this is made a number of teeth or notches not so sharp as to cut.

This plant so fibrous, and so abundant on land utterly worthless for the growth of anything more valuable, can be had for the gathering; and as paper materials are scarce, either alone or mixed with straw, would be valuable in the manufacture of that article.

Y. brevifolia.—The leaves of this plant are short, and not useful for Indian purposes, but it produces abundance of large seeds which contain much nutrition; they are ground fine, and either eaten raw or cooked in the form of mush by Southern California Indians. Vast tracts are covered with it, which assume a forest-like appearance about the Mojave river, Southern California, having trunks from ten inches to two feet in diameter, and twenty-five feet high, with numerous branches. Not only is the leaf fibrous, but the body is more so. As raw material for paper it is excellent.

Y. whipplei.—This plant in bloom is one of the finest garden ornaments, very common over most parts of California. The young flowering stems while in their tender condition, are eaten either raw or roasted by the Indians. The seeds are gathered, ground into flour, and eaten. The leaves yield a very soft white fibre which is capable of being made into very nice thread. Indians use this fibre to form a padding to their horse blankets, the outer part of which being made of the fibre from the *Yucca baccata* is very rough. A wooden needle is threaded with twine made from the same fibre, and the lining is firmly quilted to the saddle blanket forming a soft covering without which it would injure the animal's back.

Y. angustifolia, a very common plant in Utah and Arizona; the leaves yield the softest fibre of all the *Yuccas;* and, like all of them, is adapted to manufacturing purposes, especially for paper. The young flowering stems are used by Indians after the manner of asparagus; the same may be said of all the *Agaves* and *Yuccas*. They are eaten cooked or raw, and are not to be despised. The root is used after being pounded up as a substitute for soap.

Agave utahense.—The Pah-Utes strip the leaves from the heart

of the plants of this species, then heat stones, upon which the hearts are laid, the youngest leaves are next placed on, then weeds or grass, and finally, a coating of earth over all. This kiln remains three days, or until the contents are cooked, then it is uncovered. The hearts are either consumed as food immediately, or pounded fine, and pressed into flat, long, irregular-shaped cakes, about ten inches wide and fifteen long. They have a pleasant sweet taste, but the dirty black color might be objectionable to some. It is very nutritious, and the Indians of Utah become quite fat while living upon it. The tender inner leaves baked with the hearts are pounded and pressed by the hands into flat cakes, but are not so sweet or palatable as the hearts, and are full of fibres of a brown color. Its fibrous nature adapts these cakes for transportation. Indians in traveling or hunting, carry them tucked under their belts, and take off pieces as they go along to chew, spitting out the fibre or use it for gun wads. The hearts of all the *Agaves* when roasted yield this palatable kind of food.

A. deserti.—This is on the whole one of the most useful of natural productions to the Arizona, New Mexican and Lower California Indians. The heart of the plant after being roasted is a nutritious article of diet; from it is distilled a strong liquid called *mescal* by Mexicans; the seeds are ground into flour and eaten; the leaves are long and very fibrous and are cleaned like those of *Yucca baccata.* Sometimes after the leaves are dead and quite dry they are pounded until the epidermis is separated. The fibre thus cleaned is not so smooth and white as that soaked first in water, but very strong and durable ropes, mats, nets and sewing thread are made therefrom. This is a very abundant plant, covering many thousands of acres of land, unfit to grow anything more useful. A plant that contains so much fibre, surpassing in length and strength many other fibres in use for cordage and for paper, must some day be cultivated on the desert wastes of the United States.

A. shawii, one of the finest garden plants, but the fibre is only suitable for paper, being short. The Indians are very fond of a sweet honey-like nectar found in the base of its flowers; in fact it tastes like honey and water. It is only found near San Diego, California.

Willow trees.—Those along the Colorado river, Arizona, yield

abundance of long, soft bark, from which the Indians on this stream make ropes and twine for domestic purposes as well as sandals and mats. The females generally dress scantily, only that part of the body from the waist to the knees is h idden from view. This custom is observed by most of the Indian females living along the Colorado river. They strip off the bark from the willow trees and bury it in blue mud for a few days, after which it is taken out, washed clean and dried. It is now soft, pliable, and easily handled. Being cut into requisite lengths, they are fastened very thickly to a belt of the wearer.

The Colorado river Indians are said to make a fine drink from the flowers of the willows.

Apocynum cannabinum.—The Indians of Southern Utah, California and Arizona use the fibre prepared from the stems of this plant to make ropes, twine and nets; and before the advent of Europeans it was used in the manufacture of various articles of clothing. In order to remove the fibre the woody stems are first soaked in water, the bast with the bark is then easily removed. The latter being washed off, leaves a soft, silky fibre of a yellowish-brown color, which is very strong and durable. I have seen ropes made of it that have been in constant use for years.

Urtica holosericea.—The fibre of this plant is used by the Indians of Southern California to make their bow strings. In order to separate the fibre the plant has to go through the same process as hemp; its fibre resembling that of the latter, being equally strong and durable.

Cowania mexicana—This tree before the advent of Europeans was the great source from which the Nevada and Utah Indians obtained the materials for their dress goods. The outer bark is rough, but the inner is soft, silky and pliable, and of a brownish color. It is removed in long strips, varying in width, a desirable quality in a bark that is used in the manufacture of clothing, sandals and ropes. These articles were formerly made by braiding strips of bark together, or woven with the hand loom. Females made skirts from strips of this bark by braiding a belt to which they suspended many strips of the same material, hanging down to the knees like a long fringe; the rest of the person was naked in summer. Mats were also made from this bark which were used as beds.

Medicines.—Chlorogalum pomeridianum, common soap root of

California, and called by Indians and Mexicans *Amole.* It produces a large bulb which yields a great quantity of saponine, very good for washing, for which purpose it is much used by poor people and the Indians of California. The rough covering of the root is formed into bunches, tied up and used for hair brushes by the Indians.

Datura meteloides (Jamestown weed).—The California Indians make a decoction of this plant which is given to young females to stimulate them in dancing. After the root is bruised and boiled in water, the liquid, when cold, is taken internally to produce a stupefying effect, and is much used by California Indians.

The Pah-Utes call this plant *Main-oph-weep.* They bruise the seeds, soak them in water and expose the mixture to the sun's rays to cause fermentation. This being effected, the liquid is drank and has the same narcotic effect as the preparation made from the plant, or root with the alcoholic effect added.

Nicotiana trigonophylla, N. bigelovii, N. attemuata.—The leaves of all these species of *Nicotiana* are used as tobacco by the Indians of Arizona, Utah, New Mexico, and Southern California. The strength is said to be greater than that of the cultivated variety, though the leaves are smaller.

Ligusticum apiifolium, Angelica of the settlers of Utah, *Pah-net-snap* of the Pah-Utes.—It is a favorite medicine with these Indians. The root is bruised and used as a poultice for sprains and bruises. A tea is made from the roots and is taken internally for pain in the stomach. The Indians if afraid of catching contagious diseases fill their nostrils with pieces of the root. The strong, aromatic, carroty smell may have induced them to believe in the efficacy of this plant as a prophylactic.

Berberis aquifolium or *Oregon grape.*—From the roots of this plant a decoction is made in water, or they are steeped in liquor, and taken internally. It is a good remedy for general debility, or to create an appetite, and is considered equal to sarsaparilla in its medicinal virtues. It is a favorite medicine with the California Indians.

Anemopsis californica, Yerba Mansa of the Mexicans.—The root of this plant is a great remedy among the Indians of Arizona, and Sonora in Mexico, and Southern California. It has a strong peppery taste and odor. A tea made from the roots and a powder prepared from the same and applied to venereal sores are a great

remedy. The powder is advantageously used on cuts and sores, as it is very astringent. The leaves after being wilted by heat and applied to swellings are a sure cure.

Achillea millefolium, Yarrow of the settlers of Utah. The Pah-Utes make a tea from this plant and take it internally for weak and disordered stomachs. It is much used by Whites in the form of bitters.

Cucurbita perennis, called Chili Cojote by Mexicans.—The pulp of the green fruit is used with a little soap to remove stains from clothing. The roots of this plant are large and long, and when macerated in water are applied to piles, generally with good effect. The seeds are ground fine and made into mush and eaten as food by many Indians of Arizona and Southern California.

Euphorbia polycarpa, called by Mexicans Golendrina.—A strong decoction made from this plant and applied to snake bites soon produces reaction; many cures effected in this way are reported. In fact the Indians of Arizona and Southern California rely entirely upon it in such cases. Some years since, being in San Diego and wading in the salt water, a fish (*Sting-Ray*) plunged the bony projection at the base of its tail into my left foot and soon the swelling and pain became excessive; a Mexican woman made several gallons of a very strong decoction from this plant and plunged my leg up to the knee into it while hot, and in a few hours relief came.

Eriodyction glutinosum, *Yerba Santa* of the Mexicans, and a great medicine among the Indians of Southern Utah, Arizona, and California. A decoction made from this plant and taken internally for rheumatism and partial paralysis, or applied externally, is an excellent remedy. For affections of the lungs the leaves are used by smoking or chewing dry, or a tea is made from them and drank.

Micromeria douglasii, *Yerba Buena* of the Mexicans.—This is an interesting plant, growing near the sea coast of California, having a strong minty smell. It is a favorite medicine with the Mexican population of California. The Indians of the same section prepare a tea from it which is used for fevers and colds. In case of headache a quantity of the plant is bound round the head.

Artemisia tridentata, commonly called sage brush.—The Pah-Utes make a strong tea from this plant and take it internally for headache, colds and for worms. It is also a good stimulant, pre-

pared either with water or liquor. It yields a pungent oil which would be a profitable article of commerce.

A. filifolia, Southern wood.—This plant on distillation yields a very penetrating oil which is good for liniments, and the Pah-Utes make a decoction from it excellent for swellings and bruises.

A. ludoviciana, A. dracunculoides.—The seeds of these two species are gathered by the Pah-Utes, ground fine, made into mush and eaten. It is anything but a tempting dish, having a dirty look and strong taste.

A. ludoviciana.—This plant possesses medicinal virtues. The Pah-Utes make a strong tea of it and use it internally to assist child-birth, whenever assistance is required, which is seldom. In case of hemorrhage from the nose they stuff wads of the fresh plant into the nostrils.

Oreodaphne californica.—This fine evergreen tree of California has a very strong spicy odor. By rubbing the hands and face a short time with the leaves a very distressing headache will be produced. Hahnemann is not the only discoverer of the fact that like cures like; for long before he was born, the Indians of California were aware of the power which this plant had to produce a headache in those that are well and to cure those who are afflicted with it.

Erythræa venusta, a common remedy for ague by Indians and Mexicans of Arizona and Southern California. A tea is made of the plant and drank, and is certainly a very good substitute for quinine.

Pæonia brownii, by Mexicans called *Peo-neo.*—The root of this plant is used by the Indians of Southern California for colds, sore throats, and for pain in the chest. It is mealy and tastes somewhat like licorice. After being reduced to powder, it is either taken in that form internally or made into a decoction.

Grindelia squarrosa.—A decoction made from this plant is used by Mexicans and Indians of Southern California to cure colds. It is taken internally.

Lygodesmia spinosa.—This plant produces a short, fine, silky substance just at the juncture of the roots with the branches, which is used by the Digger Indians to stop the bleeding in gunshot wounds.

Perezia arizonica.—At the junction of the branches with the roots, and covering the greater part of the former is a soft, silky

substance which is used by the Apache Indians in gun-shot and other wounds, to stop hemorrhages, for which it is well adapted.

Glycyrrhiza lepidota, called by settlers of Utah, Desert root.—Pah-Utes eat it for its tonic effects. In taste it is much like licorice. Whites sometimes chew this root in place of tobacco.

Ephedra antisyphilitica, called *teamster's tea*, since men traveling with teams in New Mexico, Arizona and Southern California, camping among Indians, contract venereal diseases, and use this plant abundantly as a remedy, taken internally in the form of tea. A quantity of the plant is often taken along in case of need. This is a well-known remedy for gonorrhœa among many Indians and Mexicans. It is a strong astringent, and may prove valuable for its tonic properties.

Dyeing Materials.—Rumex hymenosepalus, a species of dock, is very abundant in sandy localities of mountain districts, and along river bottoms in Arizona and Southern Utah. Indians use the root for tanning buckskins. Moccasins made from leather thus tanned are rendered much more durable, and less liable to injury from moisture. It is also used in dyeing, as it yields a bright brown or mahogany color. Occasionally, Indians ornament their bodies by using this substance to form designs upon their limbs. Males especially, go more or less naked all the year round. The people of Utah use the leaf stem as a substitute for rhubarb to make pies.

Sueda californica.—At San Diego, California, it is commonly called glass wort, from the glassy brittleness of the stem. It yields much caustic potash, the ashes of which are used by soap makers. Indians gather the seed for food. The plant also yields a dark coloring matter.

S. diffusa, *Sah-ap-weep* of the Pah-Utes. The seeds of this plant are very small; nevertheless, they are gathered in great quantities. They are very difficult to clean, but the Indians are glad to obtain them. They are ground fine and made into biscuits. The seeds have a decidedly salty, potash taste. The flour tastes best when made into mush. The Coahuila Indians, of Southern California, make a fine black dye by steeping a quantity of this plant in water. For coloring their baskets black they take some mature rushes, and steep them several hours in this black dye, which is very penetrating, and the color is durable, but it has a very fetid, disagreeable smell.

Dalea emoryi, D. polyadenia.—Branches of this plant steeped in water form a bright yellowish-brown dye, and emit a strong rhue-like odor. The Coahuila Indians of California, to ornament their baskets of a yellowish-brown color, steep the rushes in a dye of that color, prepared from these *Daleas.*

Larrea mexicana, Tah-sun-up of the Pah-Utes.—It is one of the commonest plants of Southern California, Lower California, Arizona and Southern Utah. A lotion made by steeping branches of this plant in water, and applied to sores of man or beasts proves very efficacious, and a powder prepared from the dry leaves is good for chronic sores. From the old wood exudes an abundance of a gum which is softened and used by the Indians to cement their flint arrow heads into their shafts. The Apache Indians use this gum as a styptic. The settlers of Utah often use this plant in dyeing, as it produces a greenish-yellow color, and garments thus dyed have the curious property of emitting a very disagreeable, resinous odor ever afterwards upon being heated. In consequence of the peculiar odor of the fresh plant it is sometimes called creasote wood.

Garrya flavescens.—The fruit of this plant yields a violet coloring matter which is used by Arizona Indians. The leaves are used for ague and for colds, made into a tea and taken internally.

Trichostemma lanatum.—By Mexicans and the Indians of Southern California, it is called *Romero.* It is used by them to impart a dark or black color to the hair, and to promote its growth. A strong decoction is made of the leaves which is frequently applied to the hair. It is a very beautiful plant with bright blue flowers which emit a strong odor of hops.

Orthocarpus luteus.—This plant yields a delicate pink color, which is used by the Nevada Indians.

Eritrichium micranthum.—The slender roots of this plant yield a delicate yellow paint, used by Indians of Utah.

Lithospermum longiflorum.—The root yields a purple color; it is the Puccoon of the Eastern Indians.

Polyporus officinalis, a fungus which yields a reddish coloring matter which at one time was much used by Indians to paint their faces. Now vermilion is so cheap that it has to a great extent superseded this.

Evernia vulpina, a lichen which yields the highly prized

yellow paint found so frequently among the Western Indians. The Apaches of Arizona carry a portion of it carefully in a small buckskin bag. It is considered a charm when applied to the face, and a cross of this color on the feet enables them to pass their enemies unseen.

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THE MAPLE-TREE BARK-LOUSE.

BY EMILY A. SMITH.

THE fruit and ornamental trees grown throughout the country are affected more or less by insects belonging to the *Coccidæ* family, or as they are commonly known, bark-lice. The elm and maple are among the number, the former infested with a *Mytilaspis* and the latter with *Lecanium acericorticis* Fitch.

The first account we find of this insect is from Dr. Asa Fitch, of Salem, New York, in the Horticultural report of that State, in 1859, page 776. From that time nothing further was written until 1867, when Walsh and Riley, probably from oversight of the former article, together with figure 1, renamed the species as *Lecanium acericola* in the American Entomologist, vol. 1, page 14, since which time it has been considered under the latter name, but as Dr. Fitch has priority to the species, I would desire re-establishing the first name, *Lecanium acericorticis* of Fitch.

FIG. 1.—*a*, *Lecanium* on Maple; *b*, *Lecanium* on Osage Orange.

Throughout the eastern and western States this insect occurs quite plentifully upon *Acer dasycarpum* and *saccharinum*, and I have carefully studied its life history, which will be published in the Seventh Entomological report of

Illinois, now in the hands of the printer, from which this article is drawn. The illustrations are from the pencil of J. H. Emerton.

Mr. J. Duncan Putnam, of Davenport, Iowa, has given much time and study to the embryological development of this species; his valuable paper will appear in volume ii, part ii, of Proc. Dav. Acad. of Nat. Sciences, now in press.

During the winter months the females remain on the underside of the limbs in a dormant state (fig. 2, *a*), the beak inserted just under the bark. The greatest irregularity exists in reference to the position which they assume on the limbs, the bodies oftentimes overlapping each other, and when greatly crowded lying in opposite directions with the exception that they are always found lying lengthwise with the limb.

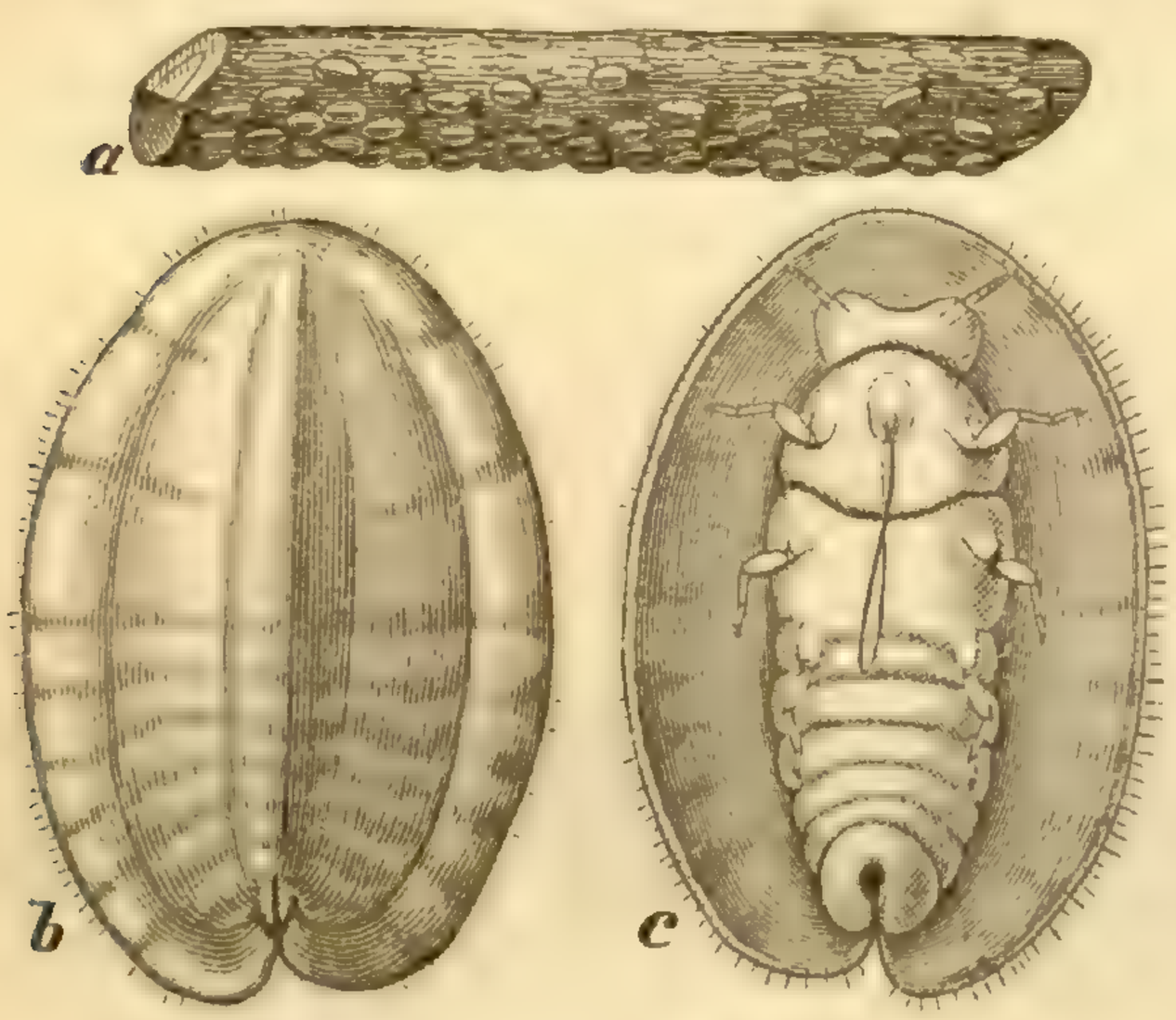

FIG. 2.—*a*, females on limb as in winter; *b*, dorsal view of female; *c*, ventral view of the same. *b* and *c* greatly enlarged.

They are at this time not over 2 mm. in length, much the color of the bark, oval in form and with a slit at posterior end; when raised from the limb the legs and antennæ are plainly visible (fig. 2, *b* and *c*). As soon as the sap commences to flow in early spring, with us near the middle of April, the insect absorbs nourishment from the tree and by the development of the eggs within the body becomes greatly distended. At this time small liquid drops are seen upon the ground and sidewalks underneath the fested trees, which is both sweet and sticky. This liquid issues from the pores of the body and continues until a waxy secretion is observed issuing from the posterior portion. This secretion issues from the general under surface but more particularly from the thorax and abdomen.

Projecting from the sides of the body can be seen, under a common lens, short thick hairs; from these points and from between the abdominal joints a portion of the waxy mass is secreted, but from around the anus comes the greater quantities.

In this cottony secretion the eggs are concealed, the work going on regularly, since we find the first eggs in the mass shortly

after it is perceived, and the insect continues partaking of the sap during the deposition. The secretion, at first is soft and sticky, but solidifies somewhat by contact with the air and remains perfect in form on the limbs after the eggs have all hatched (figure 3, *a*). A description is given below.[1]

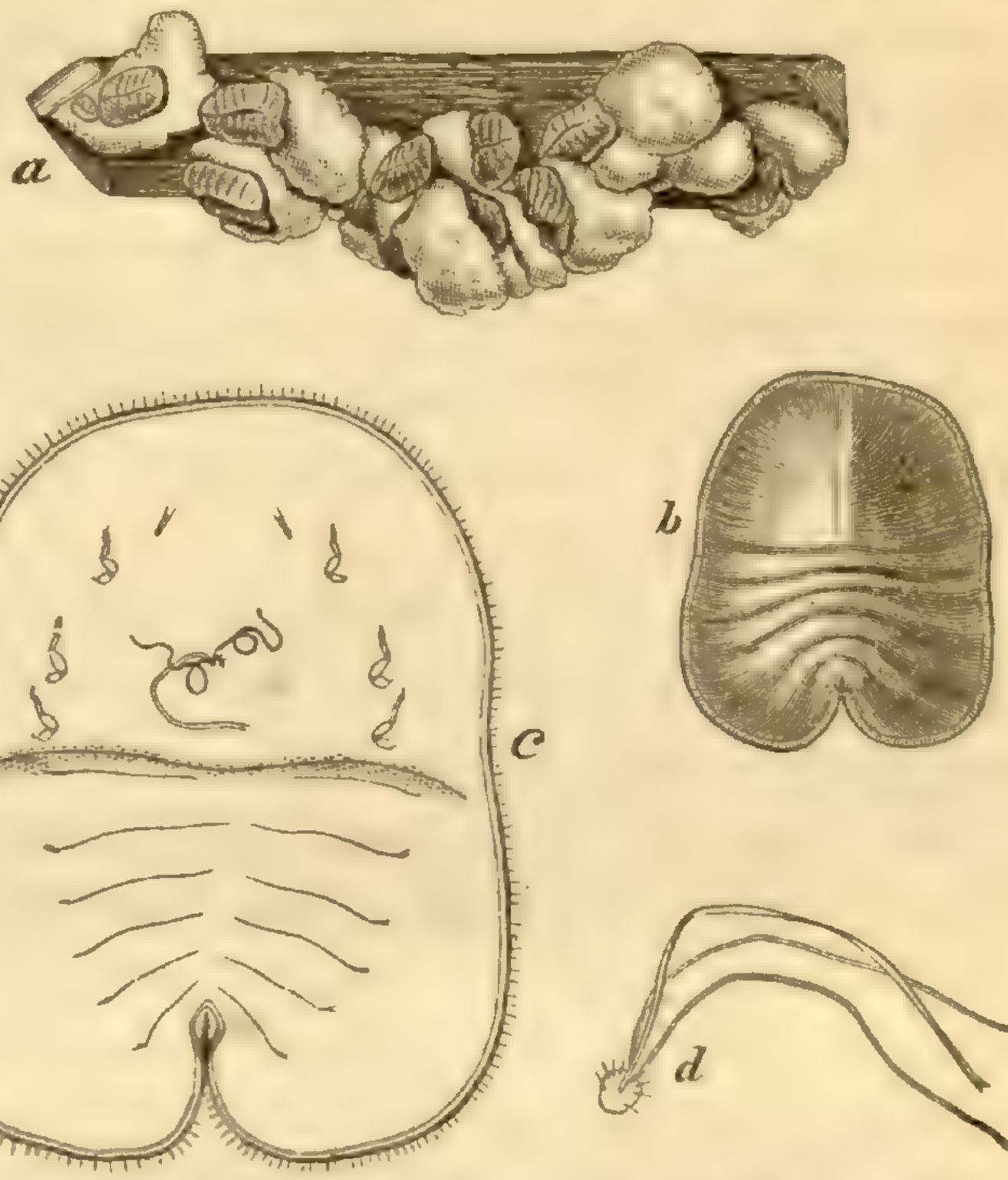

FIG. 3.—*a*, Egg mass of female; *b*, dorsal view of full grown female; *c*, ventral view of same; *d*, view of beak enlarged.

The first eggs appear about the end of May in this vicinity and are concealed in the waxy mass, the particles dividing them one from the other; these issue from the oviduct which has the opening at the posterior portion of the fissure. When the eggs first appear they are soft and pliable, but afterward harden, and as the embryos develop the color deepens. The eggs number from five hundred to one thousand, the deposition occupying from three to six weeks, the process being a gradual one. Some three weeks after the first eggs are deposited the first young lice appear and thus continue until all the eggs are hatched. The body of the female does not shrink in size as is observed in some species of *Coccidæ*, but continues absorbing nourishment until the ovisac is emptied, when she withdraws her beak from the limb and dies,

[1] *Lecanium acericorticis* Fitch, fully grown female. Dorsal view. Oval with dorsal convex carina; an anal fissure at extremity. Three thoracic and seven abdominal segments. Margin furnished with short bristly hairs. Eyes absent. Oviduct situated at end of posterior fissure. Color somewhat lurid with numerous dark blotches, the lines separating the segments darker.

Ventral view.—Antennæ and legs visible but small. The beak arises from a tubercle situated at the extreme end of the head which forms a projection extending slightly over the thorax. The beak itself is a long thread-like organ composed of four distinct pieces. The first pair of legs are nearly opposite the beak, the head and thorax occupying over one half the entire insect. Opening of oviduct at end of fissure. Length 5 mm.

the dead body remaining attached to the limb by means of the cottony secretion. Athough the antennæ and legs do not develop in the same degree with the body, they are not entirely useless, since by removing a grown female in the spring from the limb the insect will move slowly, even though in their natural condition they cease all movement after settling down in the autumn upon the limbs.

The young lice first appear about the middle of June, and are more than twice as long as broad. They are light sordid yellow, translucent, elongated-oval, tapering slightly toward the posterior end, with seven abdominal segments,the division lines being darker and plainest in the middle. Short hairs project from around the margin at regular intervals.

The antennæ and legs are situated some distance from the margin and are inserted on the underside of the body. The antennæ are armed with several strong spines and are jagged in outline. The legs are stout, terminating in a single curved claw and four knobbed hairs.

The beak is a long thread-like organ, very minute, and until the young louse becomes stationary is folded in a loop in the abdomen. At the end of the abdomen, arising from tubercles, projects two anal appendages or setæ longer than the entire body which disappear in a short time. In the natural condition the young insects settle down upon the leaves of the maple within three days after hatching, the preference given the underside and near the midrib, although they are found upon the upper side to some extent, probably because the epidermis is more tender on the under side and they are there protected from the sun's rays. The beak is at once withdrawn from its retreat and is inserted in the leaf, when the insect increases rapidly.

When in a state of rest the young lice draw the antennæ under and parallel with the last joint of the fore pair of legs. The two remaining pair extending backward.

Although they seldom leave the first assumed position until autumn, they have full use of their legs, since when the leaf is detached from the tree, the young lice will withdraw their beaks and move quite actively about in search of fresh food. When first hatched the males and females are not easily distinguished from each other; they soon, however, present quite a difference, the males becoming longer, lighter in color and somewhat higher than the others, and two anal setæ are seen projecting

from the scale. This occurs during the last week in July, and although no regular or sudden transition takes place, yet during the fore part of August the males appear, leaving behind the empty larval scales on the leaf, which are easily seen scattered about among the females upon both upper and lower sides of the leaf.

The male louse is very different from the female. During the transformation he has acquired wings for the new sphere into which he is about to enter, although he still retains the legs and antennæ, the beak is abortive, its place represented by two round spots. The three parts, head, thorax and abdomen are easily distinguished. The first males were observed August 13th, 1877, and continued appearing over two weeks. They are very active, flying about the leaves with great rapidity. At this time coition takes place, and the ovaries become developed in the impregnated females, which remain on the leaves drawing sap continually during the entire summer.

The Male-Louse.—Comparatively few of the male-lice have as yet been discovered by entomologists, and it was with pleasure that the male of *Lecanium acericorticis* Fitch was found during the summer of 1877. Their existence is for a brief period, since they are not found longer than three weeks in the year; the probable life of each individual not being over a few hours. While the female is destined to remain upon the tree during its entire existence—a few weeks over one year—the males acquire wings and fly about. That the males are necessary for the perpetuation of the species is doubted by some authors. I made an estimate of the number of larval scales on several leaves, and on the trees which had suffered a longer time, and found the average number to be greater upon a much infested and thus diseased tree than upon a healthy and vigorous one upon which the insects had not been so violently destructive. It often happens that a maple-tree will suddenly revive and outgrow the injury of these insects to an extent, even when no attempt has been

FIG. 4.—*Lecanium acericorticis*, male.

made to exterminate them. Whether this is due to the greater number of the young lice proving to be males or from the effects of parasites remains to be determined.[1]

Wings membraneous, hyaline, dotted with short points extending outward, sending out at the base a forked line, one toward the upper, and one toward the lower margin. Mons. V. Signoret says in his essay on *Lecanides*, that in the place of the lower wings of the male there are two halters or balancers, which I have been unable to discover in the mounted specimens before me, although it is quite possible that they may be found in fresh specimens. The females continue absorbing nourishment during the remainder of the summer and return to the limbs at the approach of frost in the autumn. In Fig. 1, Mr. Riley has illustrated the egg-mass as occurring upon the leaf, which is contrary to my experience in Illinois and Iowa, although were the season longer it might be the case, and thus become double-brooded since it is well known that the varied temperature has great effect upon the length of time insects remain in their several stages.

Three kinds of Lady-birds (*Coccinellidæ*), are found more or less numerous upon the infested trees destroying the *acericorticis* during the summer months. The *Hyperaspis signata* Olivier is perhaps the most abundant and valuable. The larva is small, light colored, and covered with a peculiar white downy substance. They are found inside the waxy mass devouring the eggs, and through their assistance many are thus destroyed before hatching. The outside of the egg-mass appears entire, but by carefully separating it, the larva can be observed, in the act of devouring the contents of the egg, by the aid of a common lens. Only one larva is found in each egg-mass. When fully grown and about to change to the pupa state, they emerge and attach themselves to the tree. The imago is a small black beetle with one bright red spot on each elytra.

The *Chilocorus bivulnerus* Muls. (Fig. 5), although not found in such numbers as the *signata* are equally as important since they

[1] *Lecanium acericorticis* male, see Fig. 4. Color fuliginous, with the thoracic segments darker than the remainder of the body. Head small, angular in front, and at the sides. Antennæ 10-jointed, filiform, pubescent, fourth, fifth and sixth longest. Color light brown. There are two ocelli between the antennæ. Thorax large, the mesothoracic band distinct, shiny, the metathorax forming an arched shield extending a short distance over the abdomen. Legs stout, sparsely covered with hairs, tarsi furnished with two claws at the end. Abdomen ends in a tubercle which protects the penis, the entire nearly half as long as abdomen.

destroy the young lice. The larvæ are readily recognized from the larvæ of the former by being covered with a large number of black spines, they are considerably larger, and are not found inside the egg-mass. They are ravenous feeders, and require a great number of lice before they complete their larval state. The imago resembles the *signata* in color, but is much larger and equally voracious with the young.

The *Anatis* 15-*punctata* is also beneficial in its destruction of the *acericorticis*, and is larger even than the preceding ones, but does not occur so plentifully.

The larvæ are furnished with six rows of stout spinulated spines along the body, the upper surface of which is black, while beneath it is pale, and is nearly half an inch in length. The beetle is black on the head and prothorax, having seven black spots on the brownish-red elytra, and a black spot on the scutellum; it is seven-twentieths of an inch in length.

The larvæ of a species of *Chrysopa* are found assisting in the work of destroying the enemy, but not in any considerable numbers, as also two species of *Reduvidæ* and one *Acarus*.

The females are destroyed by means of a parasite which live upon the fatty substance without disturbing the vital organs, and only destroys the insect when changing to the pupa state inside the body of the other from which it emerges through a cylindrical hole on the dorsal side. This parasite is double-brooded, the second brood appearing the middle of August. The insect belongs to the genus *Coccophagus*, thanks to Mr. E. T. Cresson for its determination, and appears to be undescribed (figure 6).[1]

FIG. 6.—*Coccophagus lecanii* nov. sp. *a*, pupa; *b*, imago; hair lines natural size.

[1] *Coccophagus lecanii*, nov. sp. Fig. 6. Body elliptical oval; color cinereous. Head as broad as the thorax, smoky brown in color, and pubescent. Antennæ eight-jointed, first joint longest. Thorax nearly black, with a crescent-shaped spot of pale yellow placed crosswise upon the hind part of the thorax. Abdomen elliptical, a little longer than the thorax. Legs light brown with the femora darker, hairy, furnished at the apex of tibiæ with a spur; tarsi five-jointed, first joint longest.

Wings membraneous, hyaline, ciliated. Fore wings with the rib vein running parallel with the margin nearly one-half its length, where it unites and ends in a stigma somewhat beyond the middle. The lower wings smaller, without veins, the hairs forming a fringe on the lower side.

THE FIRE-FLIES AND THEIR PHOSPHORESCENT PHENOMENA.

BY MRS. V. O. KING.

THE most interesting feature distinguishing these insects is their phosphorescent qualities. Light, so universal in its influences upon the life processes, and made familiar to us through the multiform media of its evolution, is known to result from a combustion of dead matter. To this known fact, *Lampyris*, creeping and flying, and at the same time emitting light, would seem to present a contradiction.

This singular fact early attracted the attention of naturalists and philosophers. A traveler in Japan, about the middle of the 15th century, studied its phenomena, discovering two kinds of light; and later, Mr. McCartney, by anatomical investigation, found two vesicles from which he supposed the more permanent light to proceed. Similar discoveries were made about the same time by a Polish naturalist. Many distinguished entomologists have given attention to the subject; even Arago studied the character of the light in connection with that of the sun, and found it to exhibit the same species of refrangibility with the light of that body.[1]

Matteucci, who studied this phenomenon from a chemical standpoint, concluded that there was positively no phosphorus present in the luminous segments, and therefore accounted for the manifestation by other means.

Prof. Pancerri of Naples, a few years since, concluded that phosphorescence in animals is the result of oxidation of certain fatty material, composed partly of epithelial cells in a state of partial decomposition, a manifestation (as Draper also says) of dead matter only; due to a slow combustion by which vibrations are excited capable of transmitting luminous rays. This phosphorescent substance, Pancerri finds secreted in glands in all cases except noctulica.

[1] The spectrum given by the light of the common fire-fly of New Hampshire (*Photinus ?*) was found by Prof. C. A. Young to be perfectly continuous, without trace of lines either bright or dark. It extends from a little above Fraunhofer's line C in the scarlet, to about F in the blue, gradually fading out at the extremities. This portion is composed of rays which, while they more powerfully than any others affect the organs of vision, produce hardly any thermal or actinic effect; in other words, very little of the energy expended in the flash of the fire-fly is wasted. Prof. C. A. Young in the AMERICAN NATURALIST, Vol. iii, p. 615.—EDITORS.

I have examined many of the Lampyridæ; the phosphorescent segments in the highly organized species contain a translucent substance resembling half-cooked starch, situated just behind a yellow waxy-looking membrane. This membrane has, on its ventral aspect four distinct spiracles for the admission of air.

Through these spiracles and contiguous parts may be seen at times quick brilliant flashes of light, made more rapid and vivid when the insect is handled, and followed in its normal state by a milder emanation, which may be compared to the embers of the previous conflagration. This second light is yellowish and dies out slowly. The first appearance of fire-flies in the twilight is indicated by a red, followed shortly by yellow, and later by the characteristic green light.

Different species vary in the degree of activity and also somewhat in the manner of emission. The phenomenon is also subject to changes during the metamorphic period.

The larva in *Photinus* emits a steady green light from the posterior segments on the ventral surface. The pupa light, at first green, soon assumes a whiter less brilliant character, diffused over the entire body.

The imago of the apterous female of *Pleotomus* exhibits greater intensity, and over a larger surface than in male forms, but steady, and at times disappearing from the posterior segments to be diffused as a white light over the body. This insect is scarcely more than an egg-bag, and its light is never so green as in other species. There is almost as great a diversity of degree and manner as of varieties, each enabling the observer to identify them at night.

A peculiar odor is perceptible, at times, in fire-flies. An English writer first noticed this, but afterwards concluded that he might have been mistaken.

The soil which is most frequented by glow-worm larvæ consists largely of decomposed rocks, and produces a growth whose ash is intensely sulphurous to the taste. In these places may also be found earth-worms filled with phosphorescent matter, and snails, the favorite food of the glow-worm larvæ, while the *Primula mexicana*, the vegetable diet of adult winged species, also abounds. All these features obtain in a moist soil and open air of fields, where, according to Ebermeyer, ozone is found in greatest quantities, and oxygen its other form.

A calcium sulphuret of phosphorus, prepared by heating sulphur with calcined oyster shells, is said to give out a yellow light when exposed to the sun's rays, but under decomposed light there is a change to green. The decomposition of certain rocks furnishes phosphates of calcium to the soil, whence having been appropriated by plants it eventually supplies animals. When not oxidized in the stomach it is supposed to be absorbed into the system in certain oils. Phosphorus in its active state ignites spontaneously in contact with the air.

In *Lampyris* we see changes identical with those presented by a calcium sulphuret of phosphorus from the red or yellow to green.

The emission of the greatest amount of light would also point to the presence of phosphorus, this occurring most freely in the open air, and when the insect is either flying or excited, when the body is presumed to be most fully inflated with air, the spiracles on the luminous segments being very favorable for its admission.

The second light, referred to as of a milder kind and with a steadier emanation, would seem to be portions absorbed by the translucent substance during the more active evolution of light, and reflected from the less permeable inner face of the dorsum until exhausted.

The uses of the light of *Lampyris* seem as doubtful as its nature. As it cannot be of service in the larval state either for sexual attraction or to secure food, its presence at this early period must be for the benefit of succeeding stages, and especially for the imago in the case of the apterous female.

The periodicity of the phenomenon may be ascribed to that property of the ganglia which enables them to give a periodical exhibition of an original disturbing cause.

There is a definite relation between the proportion of light emitted, and the color of the enclosing membrane which indicates the former's bleaching power.

Draper illustrating a truth says, that "not a shadow falls for an instant upon a wall but it leaves an ineffaceable stain," thus by his shadows bringing the power of light into bold relief. If a ray of light falls, however softly and but for an instant, upon an object, we may presume that a change, whether by chemical or mechanical means, ensues. Flowers and fruits by their irregular surfaces break the sunshine into specific hues, thus acting as shadows to themselves. Animals also respond in coloring to the influence of light.

In *Lampyris* the almost perpetual play of light, generated and partly confined within the posterior segments, has probably conduced to their final change of color. Ozone, of whose presence there is a suspicion, possibly exercises its bleaching power here as in vegetable tissues.

Assuming that the phosphorescent material is accumulated in the larval and preserved in the pupal stage for the final form, there are certain ways in which it might be useful at this latter period. The apterous female, being without food, must generate sufficient heat, from internal resources, to sustain life through oviposition.

The winged species may also utilize this power to decoy victims, and also to betray their presence to the carnivorous species, while others may kindle the torch of Hymen by this veritable flame. That both sexes possess phosphorescent properties is not surprising, since both are the product of a luminous stock, but we may expect a greater degree of phosphorescence from the female, and facts sustain this expectation.

Thus our insect seems eminently conservative in its powers, while combining the useful and the beautiful in its physical gifts.

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PHYSIOGRAPHY.

BY C. LLOYD MORGAN, F.G.S., A.R.S.M.

THE artist who is illustrating a great theme upon a large spread of canvas finds it necessary from time to time to lay down the brush, with which he is accurately filling in the more delicate minutiæ, that he may retreat to a distance and view his picture as a whole. It is essential to the higher development of his art that he should not omit this comprehensive survey. The same thing holds good in literature and science, as well as in art. The historian must, from time to time, take a fresh survey of history as a whole. If he neglect to do so, the group of figures to which he devotes his special attention will certainly not take up its true position among the other groups that appear on the canvas of history. The man of science, also, should not forget that he is, according to his individual bent or capacity, aiding in the construction of a great philosophy; and he should now and again turn aside from the microscope, or lay down the hammer, to take a

more comprehensive survey of that philosophy, whose aim it is to comprehend and consolidate the widest generalization of science.

A rude attempt at such a survey of the principles of geology and the bordering branches of science will be found in the following pages. They are from the notes of a lecture which formed the last of a course delivered before a school audience. In that lecture I did my best to give a rough sketch of that chain of events by the study of which we may build up a history of the Earth, while I endeavored at the same time to lead my hearers upwards from the simple to the complex ; for I hold that the teacher of science should lead his pupils from the well known, through the less known, to the unknown. Taking a few simple and obvious facts as a basis, he should first test whether those whom he teaches really know them to be facts, and then, carefully building upwards, seeing that each stone of his superstructure rests securely on one which has before been firmly laid down in its true place, he should mount slowly and surely, until, at last, he reaches that rare atmosphere of the unknown in which, for the present at least, no man may build.

Standing by the sea-side, then, let us inquire of Nature concerning the things which we see around us. The waves roll in upon the shore, the wind blows freshly in our faces, a heavy storm-cloud hangs over the distant horizon, at our feet is a little streamlet running over the sands to the sea ; behind us is the white chalk cliff, capped with sand and clay.

How come these waves, and what are they doing? shall be our first question. The answer to the first part of the question is so obvious that a child will not hesitate to reply, that it is the wind which produces the waves. At first a mere cat's paw on the surface of the sea, the growing ripples are, as the wind continues, hurried onwards, increasing both in length and breadth, and, where the water is deep, in velocity of motion, until they become the great waves, some fourteen feet high from trough to crest, which we see on our coast during a storm, and finally, if they have a fair field, develop into ocean billows, twenty-six feet high in the Atlantic, forty feet high in the Southern Ocean. In the open sea the water is not carried forward by this wave motion. We may watch the sea-bird rise and fall as the wave passes under her. She is not carried forward on its summit. But when the wave

reaches shoal-water, in the neighborhood of land, the lower part is retarded by friction against the bottom, while the upper part hurries on, and the wave breaks, and rushes up the shore, the under water racing back and tearing up the beach in its backward course. It is in this way that the sea has such power in grinding down the rocky materials which fall to the base of our island cliffs. Along the Chesil Beach the pebbles are carried forward fifteen miles by the action of the waves, and as they grind over each other in their westward course, they become smaller and smaller.

Here then we obtain an answer to the second part of our question: What are the waves doing? They are beating backwards and forwards the matter which falls from the cliffs, until it is broken up and rolled into a rounded pebbly beach. But they are doing more than this. They are battering at the cliff itself, and aided by rain, and frost, and wind, are eating away our island shores. The force with which the waves dash against the cliffs is at times enormous, having been known to reach a pressure of more than three tons on the square foot. During the hurricane which swept over Barbardoes in 1780, cannon which had long been lying sunk were washed far up on the shore.

In some parts of England the sea is advancing rapidly on the land. Prof. Huxley, in his excellent little book on Physiography,[1] quotes, as an instance, the fact that Reculver church, which in the time of Henry VIII, was a mile from the sea, is now only preserved from the destructive action of the waves by a stone breakwater made by the Trinity Board. Not long ago, I walked along the coast from Herne Bay to the Reculvers. The rapidity of the waste was clear. In many places portions of the path had been carried away. Masses of grass-covered earth, lying at the foot of the vertical portion of the cliff, showed how recent had been the precipitation from above; while the clean-cut face of the cliff, and the sharp forms of the projecting ridges and pinnacles of the clay showed that since they were left in their present position, they had not suffered for long the attacks of rain and wind. Great cracks at the surface, here and there, showed that destructive action was still in progress; and when I looked at the lately fallen blocks of earth below, I felt that it was possible that the grass tufts, on which I stood, might be the next to fall amidst the

[1] 8vo. pp. 384, with 5 plates and 122 woodcuts (Macmillan & Co., London, 1878).

ruins beneath me. But though the action of the weather was thus clear, the sea-waves, which alone permitted that action to continue, were not idle. The brown color of the sea for some distance from the shore gave evidence of this, and while I stood upon the beach, I saw several projecting blocks of clay wasted by more than half.

In Scotland and Western England, where the rocks are hard, the advance of the sea upon the land is quite imperceptible. All the beauties of our coast scenery, our bold headlands and sweeping bays, result from this *unequal* action of the sea upon the harder and softer rocks of which our island is built up. But little observation is necessary to make it clear that, along any coast-line, the promontories are composed of hard rock, the bays of a softer material. Sea-side scenery is, therefore, a joint product of wave action and the geological structure of the coast. We must not forget, however, that it is only along its margin, where it beats upon the shore-line, that the sea is an agent of *denudation.* Throughout its great extent the ocean is the area of deposit and construction, just as the land is the area of destruction and waste. Beneath the sea the products of that waste come to rest. Strange as it sounds, the sea is the cradle of the land. Beneath the waters of the ocean are formed those layers of sediment which will some day be raised above the waters to form the framework of new continents.

From the answer to our first question, then, we learn that the waves are advancing upon the land, and thus producing our coast scenery, and that they are caused by the winds.

Let us next consider the streamlet at our feet. What is it doing, and how comes it here? That little streamlet, if we will but listen to it, can tell us much about what the great rivers of the earth are doing. Let us learn from it. In the first place, then, we see that this miniature river[1] is gradually changing its course. The main current strikes against one bank more than the other. The result is that this bank is forced to recede. Its tiny cliffs are undermined by the action of the stream, and the upper portions, now and again, topple over with a little splash into the water. Here we have in miniature that which may be seen on an enormous scale on the Mississippi and the Amazons. Large vessels may there be made to rock by the waves created by the fall of

[1] Miniature Physical Geology, *Nature*, March 8, 1877.

great masses of the concave bank, the river having in this way advanced upon the land hundreds of yards, and, in some cases, even, several miles, within the memory of living men.

This shows how a stream cuts its way *sideways* into the land. This is not, however, the most important part of what a river does. If we follow our stream a little way inland, we shall discover that it cuts its way *downwards* and cuts it way *backwards*. Both modes of action go on, as a rule, at the same time; but sometimes one, sometimes the other, is most obvious. Of the first, the Cañon of the Colorado offers an example on the grandest scale. This great ravine is about three hundred miles long and, in places, *more than a mile* deep. There can be no doubt that it has been entirely cut down into the desert plateau by the action of the river. How this was effected we learn, to some extent, from the following sentence in the American report on the river, "The water of the Colorado," says the reporter, "holds in suspension a large amount of fine siliceous sand, sharp as emery, that eats away the valves" (connected with the machinery of the steamer) "as rapidly as it could be done with a file." It has probably been with the aid of this sand that the river has cut down its deep trench.

Of a river cutting its way backwards, the Niagara is the grandest example. At the Falls the water tumbles over a ledge of limestone which rests on a thickness of shales. By the action of the spray which rises from the waterfall, and partly by the power of frost, the shale is rotted away, and thus the limestone is undermined. It is in part owing to the undermining action, that visitors can proceed a little way under the Falls. To do so is well worth a wetting; a whole river takes its mighty leap, and falls with a bewildering roar at your very feet, and if it be winter giant icicles hang above your head. When the "under-cutting" has gone on for a certain time, huge blocks of the limestone tumble with a crash to the base of the waterfall. In this way the Falls of Niagara are working backwards, at the rate of about one foot a year, towards Lake Erie. Only the other day it was stated in *Nature* that, on November 17, 1877, a large section of the rock towards the Canada shore fell with a tremendous crash, and that during the night a still larger area went down.

But what becomes of all the material dug out by the stream as it cuts its way sideways, or downwards, or backwards? If we

watch any little rill which falls into a pool on the sea-shore, we shall soon find out. We shall see that the sand and other material which it carries are built up into a little delta, while some of the finest material is spread at large over the bottom of the pool. Large rivers carry vast quantities of mud and sand and silt (much of which is washed off the land by the rain) to the sea. Experiments of mine on the Thames, at Surbiton, show that in fine weather, when the river was low and fairly clear, solid matter in suspension was being carried seawards at the rate of 9767 tons per annum; while, when the river was in extreme flood, matter at the rate of 524,940 tons per annum was passing in this way down towards the sea. With the great rivers of the world of course the amounts are still more enormous. Sir Charles Lyell calculated "that if a fleet of more than eighty Indiamen, each freighted with about 1,400 tons weight of mud, were to sail down the Ganges every hour of every day and night for four months continuously, they would only transport from the higher country to the sea a mass of solid matter equal to that borne down by the Ganges in the four months of flood season." All the matter carried down in this way is built up, layer upon layer, into a vast delta deposit, or strewn over the bed of the ocean. Of such layers much of the crust of the earth, the sand and clay at the top of the cliff behind us for example, is composed.

But besides the matter carried down by rivers in suspension, a vast amount is carried down in solution. Take the Thames for example. For every grain transported mechanically, more than twenty grains are carried down chemically. Every gallon contains some twenty grains of lime salts, and about two grains of common table salt, or chloride of sodium. These also are carried out into the sea, in which the chloride of sodium, along with certain other salts, accumulates on the evaporation of the water, and thus forms the brine of the ocean, while the carbonate of calcium is separated by living creatures and built up into some sort of pure limestone. Of such limestones also much of the crust of the earth, the chalk of the cliff behind us for example, is composed.

We have thus seen what the streamlet is doing. It is aiding the rivers of the world to carve out valleys, and it is carrying seawards the fine mud and sand which result from its own work and that of rain, to contribute to the framework of a future continent.

And how comes it here? Directly or indirectly from rainfall. Whether its source be a spring, or the collected waters from a sloping hill-side, it matters not. Without rainfall, such as is now pouring from the distant storm-cloud, the streamlet could have had no existence.

Another question therefore suggests itself: What is this rain-fall doing, and how comes it here? If we walk along the shore for a little distance, we may perhaps see (if there is beneath the cliffs any clayey material containing flat stones) small pillars of earth, each capped by one of these flat stones. These are little monuments of rain action. Rain falls upon the surface and runs off towards lower levels; as it runs, however, it carries with it a little of the fine clayey material. Thus it lowers the surface. But where there is a flat stone, the surface is protected from the soft-ening action of raindrops, just as a house is protected by its roof. The soil beneath the stone is not carried away, and the miniature earth pillar stands out as a monument. In Switzerland there are, in several places, earth pillars fifty or sixty feet high, which have been formed in this way.

But it is not only where there are earth pillars that the rain is exercising a denuding action upon the land. If we go out into the fields on any rainy day, we may watch how the soil is liter-ally flowing downwards to the sea. Few fields are perfectly flat, and the rain which falls upon the surface tends to drain off at the lowest possible level. But if we examine the water which is thus on its way down the field, we shall at once see that it is not clear, that it carries with it some of the soil. Much of the rain, of course, sinks into the ground. But before it does so it is nearly sure to trickle a foot or two over the surface. Even if it only runs a few inches, it must bear with it some of the soil for this distance, and there leave it. If the rainfall continue, the soil is soon carried a few inches further; and it always travels in one direction from higher to lower levels. Our field may be separated at its lower end from another by a wall, which will check the downward progress of the soil. If this be so, we shall often find that, from the accumulation of this soil, a child may look over the wall on that side of it which faces up hill, while a full-grown man may have to stand on tiptoe to gain the same advantage on the lower side. Or perhaps at the bottom of the field there may be a ditch; that ditch may communicate with a streamlet, and the

streamlet fall into a river. Some of the soil of the field is thus carried by every heavy shower of rain into the ditch, and thence into the river. After a wet day we shall find that all the tiny rills, the little rivulets, the streams, and the great rivers themselves, are muddy and thick. This mud is nearly all derived from the soil of the land which lies in the river-valley. Thus the land is always flowing downwards to the sea; not a particle can get up again when once it has flowed even a few feet in its downward course; and this action is going on wherever rain falls upon the surface of the land.

But though the surface layer is, in this way, being constantly washed off the fields, the soil does not lessen in quantity. For as fast as material is carried away by the rain, so fast does the same agent, aided by weathering action, prepare fresh soil, to be treated in a similar manner. At the same time we must remember that, though the amount of soil does not grow less, the amount of land above the waters of the ocean does diminish. Does this seem strange? A rough analogy may serve to make it clear. A man possesses a certain amount of money, most of which is in the bank, and a small amount for immediate use in his waistcoat pocket. As fast as his ready cash disappears he draws a check on his banker, and in this way his waistcoat pocket has a more or less constant supply. Practically speaking, therefore, his ready cash does not diminish, though his balance at the bankers does not remain equally constant, but decreases day by day, at a rate which would shortly lead to bankruptcy if he were not careful that there should be a supply equal to the demand. Now the soil is the ready cash, and the strata of England the balance at the bank. Rainfall is continually tending to diminish the amount of soil or ready cash, which is made good by a fresh supply from the bank. It is perfectly obvious, however, that the balance at the bankers must decrease, and that in the course of ages England must be entirely washed away into the sea of geological bankruptcy unless the bank receive a fresh supply; unless, in other words, by the force of elevation, fresh land be raised from time to time above the waters of the ocean.

With regard to the influence of rain on the physical aspect of a country, it may be said that viewed on a large scale and in a general way, this agent exercises a softening effect on scenery; in those areas where the strata are of a soft and easily yielding

nature, the work of rain as an earth-sculptor is to cause the land to assume a gently undulating form, and to extend in *breadth* those valleys which rivers are always tending to extend in *depth*. On those rocks, however, which are of a harder nature, rain has less absolute power, but even here it renders the scenery less rugged; less sublime perhaps, but more beautiful.

And how comes this rain? We know that it falls from the clouds. We know too that these clouds are formed when the air above is cooled so much that it can no longer hold in solution all the vapor of water which it has borne in an invisible form from afar. The rain, therefore, comes from the vapor of water existing in the wind. And how comes it to exist in the wind? It is obtained from the Atlantic Ocean. Thither then we must travel in thought and try and picture to ourselves what takes place when the visible liquid water is converted into the invisible gaseous vapor of water. Now it is quite evident that some force is overcome—some binding force which drew the particles of water closely together. This force is cohesion. It may be likened to a strong man who holds the watery particles in bondage, not indeed so severe as that of the terrible ice-king of the Arctic and Antarctic regions, for they are allowed free motion among each other and are not locked in the solid state, but still *bondage* chaining them down to the limits of the ocean. This strong man will not loose his grip until he be conquered by a stronger than he; and on the Atlantic he meets with that stronger man whom we call heat.

Sun-heat sets free the particles of water from the bondage of cohesion, and allows them to escape into the air. But the mastery is not gained without an effort, and the value of this effort has been calculated. To emancipate nine pounds weight of water particles, an amount of energy has to be expended, equal to that of lifting a ton to the top of a precipice 2900 feet high.[1] But just as, when two wrestlers struggle together, neither can master the other without a true waste of his substance taking place, a waste that has ere long to be made good by the absorption of a certain amount of mutton or beef, so too on the Atlantic, during the struggle between cohesion and heat, a certain amount of the latter is consumed and disappears. The amount of heat so expended has also been calculated. In setting free nine pounds of water particles an amount of heat disappears sufficient to fuse forty-five pounds of cast iron.[1]

[1] These are two different ways of stating the *same* fact.

To take leave of metaphor, this amount of heat is expended in overcoming cohesion and tearing asunder the particles of water. The vapor particles thus formed, kept separate from each other by heat, are carried by the wind to our shores; there the air in which they float is cooled; the heat is now insufficient to overcome the force of cohesion, and the water particles, no longer held apart, clash together, and as they do so they generate by the shock as much heat as was expended before in tearing them asunder. All the heat which disappeared—was rendered latent or hidden—when the vapor of water was raised from the Atlantic, is set free or rendered sensible when condensation takes place. For every nine pounds of weight of cloud formed in our skies, an amount of heat is set free sufficient to melt forty-five pounds of cast iron.

A valuable lesson may be learned from this behavior of water and water vapor. When the liquid water became gaseous vapor a certain amount of heat energy disappeared. But it was not destroyed. It was converted into another form of energy which we may call the energy of separation. The particles were forcibly *separated* from one another, and a certain amount of energy was necessary to keep them apart. Presently, however, they clashed together again and the energy of separation was reconverted into the energy of heat. The amount of heat given out was exactly equal to the amount of sun-heat absorbed. Day by day fresh experiment and observation make clearer this great law of nature: that by no means at our disposal can we either destroy or create energy. We may change it in a number of ways. We may convert chemical separation into electricity, this into mechanical motion, and mechanical motion into heat. But we can neither call into existence or put out of existence any portion of the energy of the universe, any more than we can call into existence or put out of existence any portion of the matter of the universe.

One more fact must be noticed. Though the same amount of heat is given out by the condensation of the aqueous vapor as was absorbed on the Atlantic during its formation, it is no longer useful in the same way. It does not possess the power of again converting water into water vapor. It has become degraded. It is the same in amount, but different in value. The water which turns a mill is the same in amount whether it lies above or below the water-wheel, but it differs vastly in value. That above the

mill is useful to the miller, that below the mill is useless. It is the same with energy. Just as water tends to run down from higher to lower levels, so does energy tend to run down from higher to lower forms. All forms of energy tend to be degraded to heat uniformly diffused throughout space.

To the energy of sun-heat, then, we owe the existence of vapor of water in the wind. And to what do we owe the wind itself? To the same cause. On any winter's evening, the colder the better, we may make the following experiment, first performed by Franklin: When the dining-room is warm but the hall outside cold, we may throw open the door to its full extent. On holding a lighted candle in the doorway near the top, we shall find that the flame is blown outwards; on holding it near the bottom, we shall find that it is blown inwards; midway between the top and the floor the flame will burn steadily. The cause of this is obvious when we remember that warm air is lighter than cold air. When the door is opened warm air rushes out near the top, and to supply its place cold air rushes inwards along the floor. The two currents are divided by a calm.

At the seaside we may watch the same sort of experiment performed on a larger scale by nature. In settled summer weather sailors count on a sea-breeze in the morning, and a breeze from the land at night. The cause of these land and sea-breezes, with which every yachtsman is acquainted, is simple. In the morning the sun shines alike on land and sea, the land, however, most readily takes up the undulations of heat. The air above the land thus warmed expands, and forms an upward current, while a refreshing breeze comes along the surface from the sea, just as a cold current passed along the floor from the hall.

At nightfall the reverse is the case. The sun withdraws his rays from land and sea; but the land, which was the first to be heated in the morning, is the first to cool in the evening. Soon it is as cool as the sea. Ere long it has become colder than the sea. And the current now sets outwards from the land. We have changed the conditions. We have brought a refrigerator into the dining-room, and the lower cold current now sets outwards into the hall. It is, of course, under ordinary conditions, only the under current which we on the earth feel. The upper current is far above our heads. A French balloonist (Tissondier) rose from Calais into the upper current, and was carried far out to sea; on

descending he entered the under current, which bore him safely back to Calais.

The same laws are seen in operation in the Indian Ocean. There for half the year the North-east Monsoon which blows *from* the continent of Asia is the prevalent wind. During the summer, however, it is forced back by a South-west wind, caused by the great upward draught over the glowing plains of Central Asia.

Far away on the broad Atlantic and Pacific Oceans, we may see the same thing on a scale so magnificent as to form a healthy and vigorous circulation for the whole world. In the great system of winds, of which the trade winds are the most constant, we have mighty currents of air which sweep from pole to pole, and are the very life of the earth over which they pursue their ceaseless course.

Thus the existence of the winds is due to sun-heat.[1]

Let us pause here for a moment to see what we have learnt. We have seen that the waves which beat on our shores, and denude our coast-lines, are due to the winds; that the rivers which cut down trenches into the earth are due to rain, which is itself brought to us as vapor of water by the winds; and we have seen that both the formation of water-vapor, and the existence of the winds, are due to sun-heat. This sun-heat is therefore the highest link we have yet reached in the chain of causation. We have also seen incidentally that the sand and clay at the top of the cliff were built up of mud and sand grains, carried down mechanically by rivers to the sea: and that the chalk has been separated by living creatures from the sea-water to which the lime had been carried down in solution by rivers. The question—how came this life upon the earth?—now arises. It will not however be discussed here. It is enough to state that it is almost universally believed by those competent to give an opinion, that all life forms have come into being by a process of evolution from primitive organic germs. It may be noticed, however, that all life, whether vegetable or animal, is made possible only by *solar energy*. Animals depend on plants, directly or indirectly, both for the food they eat and for the air they breathe. In the absence of sunlight plants would be unable to decompose the vast quantity of carbonic acid which animals breathe forth: and thus *their* source of carbon and our source of oxygen would be cut off.

Another question must now be put and shortly answered. The

[1] Their direction is modified by the rotation of the Earth.

sand and clay and chalk which form our cliff were laid down beneath the sea; how come they now to form dry land? Now it is clear that one of two things must have taken place: either the level of the sea has been depressed or the land has been raised. Geologists do not hesitate to say that it is the land which has undergone the change in level, while the sea has remained stationary. The sea is, in fact, more stable, more constant, more ancient than our oldest continents. All land is, on the other hand, subject to changes of level. In the Himalaya mountains shells, which once lived in the sea, are found at an elevation of 16,000 feet above the level of the ocean. The northern part of Scandinavia is even now slowly rising, while the southern portion is undergoing depression. But how? There lies the question.

It is now well known that the earth is, in the interior, in an intensely heated condition. In deep wells and mines the temperature rises about 1° Fah. for every sixty feet we descend. The melted lava poured forth during volcanic eruptions gives us some idea of the temperature comparatively near the surface. The centre of the earth must then be hot beyond conception. But it is gradually cooling. Heat is flowing outwards through the crust into space: the cooling of the earth is accompanied by contraction of the mass of the earth: and unequal contraction produces areas of depression and elevation.

Is this clear? Perhaps a comparison of great things with small will make it clearer. The human mind seems at times to fail to grasp facts which are, in truth, simple, but which from their magnitude are hard of conception. If, for instance, we stand on a high peak and look out over a portion of a great mountain chain, and see the grand summits standing out along the central ridge, it is difficult to conceive how this grand upheaval could have been produced; and perhaps the mind, wearied with the attempt to grapple with a subject almost too great for its powers, finds relief in the thought, that the mighty elevation was due to some great cataclysm or convulsion of nature, concerning the cause of which —as a matter beyond our ken—it would be rash to speculate. And if it were then suggested that mountain chains, such as that in the midst of which we were standing, must be the inevitable result of the contraction of a cooling globe, it may be that our understanding would reject a conclusion which it could not at once grasp.

But if when we have left the mountain top, we take up a withered apple of last year's growth, the consideration of its surface may help us to understand that which before was so hard to comprehend. When we plucked that apple, a year ago, its surface was smooth, and the skin was stretched tightly over the fruit beneath. But since that time the apple has shrunk in size, the fruit having contracted within the skin, which, no longer tight and glossy, is now wrinkled and puckered up.

But just as in the apple, so too in our planet, there is an inner portion which is contracting, and an outer portion which does not shrink: and as surely as the earth is losing heat by radiation into space, her mass contracting and her size growing less, so surely must the outer portion become puckered up, the most prominent wrinkles forming what we call mountain ranges.

While *sun-heat*, therefore, enables rain, rivers, and the sea to denude the land and to combine in the formation of new continents, *earth-heat* causes a fresh supply of land to be raised above the waters. Were it not for this earth-heat, England, as already, mentioned, would during the course of geological time be entirely washed into the ocean of geological bankruptcy. All geological action, except that due to the tides, is brought about by sun-heat or by earth-heat.

Before inquiring what is the cause of this sun-heat and this earth-heat, there is one more question to be answered. Of what does the air, the water, the cliff, ultimately consist? Are earth, air, and water, as the ancients believed, elements? No. The air is composed chiefly of a mixture of a gas called nitrogen with one-fifth of its volume of oxygen. It is not difficult, as will be seen in Professor Huxley's book, for the chemist in his laboratory to separate these two gases. Nor has he much difficulty in splitting up water into the two gases, oxygen and hydrogen; while the further task of ascertaining of what the solid crust of the earth is composed, though it requires more labor, is by no means beyond his powers. But whereas water contains but two elements, in the solid crust of the earth there are about sixty-five. But what are these elements? They are simple bodies which resist every effort of the chemist to decompose them into simpler bodies. Many chemists, however, believe that, though we cannot by any means at our disposal thus split them up, this is only because the means at our disposal are limited, and that, at an

intensely high temperature, all would be found to consist of one primitive form of elementary matter.

One of the most striking results of modern scientific inquiry is the discovery, by means of the spectroscope, that there exists in the sun's photosphere some sixteen or seventeen at least of the so-called elements, with which we are acquainted on the surface of our earth. Herein lies one of those many bonds, by which we are connected with our central luminary. The cause of these bonds; the origin of sun-heat and earth-heat; and of the sun and the earth themselves, now require elucidation.

According to the now-generally-accepted theory, known as the Nebular Hypothesis of Kant and Laplace (and it must be noted that we are here passing from the well known to the less known), our solar system was formed from a diffuse nebulous mass. We must imagine that this rotating spheroid mass once extended to the furthest limits of the solar system, beyond the orbit of Neptune. It radiated heat freely into space, and under the force of gravitation underwent contraction. And as it contracted it left behind it rings of vapor which, breaking up, formed secondary rotating spheroids, themselves contracting, themselves leaving behind them rings, forming tertiary spheroids, themselves passing in their orbits round the central mass. That central spheroid mass is the sun; one of the secondary rotating spheroids is the earth, the moon being a tertiary spheroid. The earth-planet thus formed was gaseous; but as time rolled on, it passed through the liquid state, to the more or less solid state, which it at present possesses.

Sun-heat is therefore the result of the condensation of the primary spheroid: earth-heat the remnant of that produced by the condensation of a secondary nebulous spheroid.

And now comes the question, how was the rotating nebulous spheroid formed?

If we take a small piece of lead and deal it a number of heavy blows with a hammer, we shall find that the lead becomes hot. If we continue to hammer for ten minutes, we shall find that the lead becomes too hot to hold. Now what is the cause of the heating of the lead. Simply this: when the lead is struck, the motion of the hammer is suddenly stopped; but the motion is taken up in a new form by the particles of the lead, and this new form of motion is heat. The visible motion of the hammer is converted into the invisible molecular motion of heat; for heat is simply the rapid vibration of the ultimate particles of matter.

When a bullet is shot from a rifle against an iron target, the rapidity of the motion is suddenly arrested; heat is developed; and this heat may in some cases be sufficient to melt the point of the bullet. In the same way the immense iron shot, hurled from our modern pieces of ordnance, cannot fail to be intensely heated, when they strike against the sides of such a ship as the *Inflexible*. It is quite conceivable that a shot or bullet of lead might be projected with such violence as to be, not only fused, but converted into vapor on striking the target. For when the motion of heat becomes extremely violent, the particles of matter are shaken asunder, and a vapor is formed.

We may take the velocity of a rifle bullet to be 225 feet in a second. The velocity at which the earth moves through space, as she travels round the sun, is about nineteen miles in a second. If we imagine that the earth were suddenly to strike a huge target, the heat generated would be sufficient, not only to fuse the earth, but to reduce it in great part to vapor. "The amount of heat thus developed would be equal to that derived from the combustion of fourteen globes of coal, each equal to the earth in magnitude. And if, after the stoppage of her motion, the earth should fall into the sun, as it assuredly would, the amount of heat generated by the blow would be equal to that developed by the combustion of 5600 worlds of solid carbon."

Now, it is supposed by Dr. Croll and others (and here, be it noticed, we pass to the still less known; to the purely hypothetical, but still conceivable), that the nebulous mass from which the solar system has been evolved resulted from the collision in space of two vast masses moving at great velocity. Each of these masses may be supposed to have developed from a nebulous mass, in the same way that the solar system has itself developed. Such nebulous masses were endowed with that high form of energy, which may be termed, generally, the energy of separation. But we have seen that this and all other intermediate forms of energy tend to run down, and be degraded to heat uniformly distributed throughout space. Some men of science tell us that this will be the ultimate condition of the energy of the universe. They tell us that the planets will fall into the sun, and that thus the matter of the solar system will be aggregated into one mass, that this mass coming into collision with another mass similarly formed will produce the nebulous spheroid from which another

system greater and grander than ours will be formed, and that so the same thing will go on until all the matter of the universe is aggregated into one mass, and all the energy of the universe is converted into uniformly diffused heat.

But here have transcended the powers of the human intellect. We have reached that thin atmosphere in which we can no longer build. We have traced the chain of causation as far as we are able. We have reached the Unknowable. When we seek to go further; when we inquire what is *matter*, what is *force*, what is the *ether* through which force acts on matter, what is the *space* in which co-existences are manifested, and the *time* in which sequences are manifested; when we inquire what is consciousness, what is the *thought* by which we are able to trace to some extent the chain of causation, we are met by alternative contradictories. We are in the presence of the Mystery of Mysteries. Let us humbly, modestly, truthfully confess our ignorance.

It may, perhaps, be said that there is much in the foregoing pages that is quite out of place in the *Geological Magazine*—much about wind and aqueous vapors, the Nebular Hypothesis and the Unknowable. But is it out of place? If there be any truth in my opening paragraph—that just as an artist has now and again to view his picture from a distance, so does the man of science have from time to time to take a comprehensive survey of his subject—No. In any consideration, however imperfect, of the work which Geology is doing for Modern Philosophy, we must weave that work into the general picture presented by the study of Nature. This I have attempted to do. In the place I have endeavored to point out the law of causation; that all that we see about us has been *caused* in some way or other. In most cases, from the nature of the subject, this law of causation has been illustrated qualitatively; but in the case of the formation of water-vapor the quantitative truth of the law has been indicated; and the law of the conservation of energy briefly alluded to. In the second place I have tried to show, as far as was possible in the space at my command, how the crust of the Earth has been built up by the mechanical agency of rivers, forming deltas, and the vital agency of simply-constituted creatures. By these two agencies nearly all the rocks have been formed, with the exception of salt, and, perhaps, magnesian limestone, which are due to chemical agency. By the action of earth-heat and other causes, however,

some of these rocks have been so altered that their original source is scarcely, if at all recognizable. How this earth-heat has raised the strata, thus formed beneath the sea, above the waters of the ocean, has been pointed out; and the action of the sea-waves, and of rain and rivers in carving out the face of the country, horizontally and vertically, has been indicated. In tracing the chain of causation from the well-known to the Unknowable, I have not followed the example set by Prof. Huxley in the excellent little book which bears the same title as this article. In these days, however, when we hear so much of the "pride of Science," it is well to point out that in the study of Nature we reach at last ultimate questions, with respect to which we must one and all confess with modest humility that we are and must be ignorant. Finally, in making each fact the effect of one which had gone before it, in time, and the cause of one which followed, I have aimed at that *organization* of knowledge, without which any number of accumulated facts are but isolated pieces of general information.—*Geological Magazine.*

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RECENT LITERATURE.

BREHM'S ANIMAL LIFE.[1]—The third volume of this interesting series, which is to comprise in all ten large octavo volumes, is at hand, and perhaps the present one is as valuable and entertaining as any, since it treats of the horses and Ruminants, and the seals and Cetacea. There are one hundred and twenty wood-cuts of the same general excellence as those which appear in this notice, and there are besides twenty-one full-page plates; those of the Shetland pony, zebra, ibex, jak, stag, bison, rhinoceros, wild boar and sea lions being especially attractive, and apparently faithful studies by the most eminent German zoölogical artists. Among the wood-cuts the antelopes, elands, spring-bock, hartebeest and their allies, are well rendered. The figures that we have selected are fair examples of the artistic work. The American reader will find that some of the characteristic ruminants of his country are well drawn, as in the Rocky Mountain sheep (Fig. 1), and the musk ox (Fig. 2). The hippopotamus is well drawn, especially its head and face, and its skeleton (Fig. 3.) is represented, while the account of it by Dr. Brehm is detailed and fresh. The

[1] *Brehm's Thierleben.* Allegemeine Kunde des Thierreichs. Grosse Ausgabe. Zweite umgearbeitete und vermehrte Auflage. Erste Abtheilung. Säugethiere. Dritter Band. Leipzig, 1877, 8vo. For sale by B. Westerman & Co., New York, at 40 cents a part.

excellent drawing of the walrus is too large for us to reproduce in these pages, but as a skeleton has lately been exhumed at Portland, Maine, and skulls have occurred as far south as Virginia, and are likely to occur at other points, we have, by permission of the publishers inserted a figure of the skeleton (Fig. 4).

The chapter on the *Sirenia* is full and entertaing, the dugong of the East Indian seas (Fig. 5.) is apparently well drawn, as is

FIG. 1.—The Rocky Mountain Sheep.

the lamantin or manatee of South America. While the account of the latter animal is fair, the northern limits of its distribution in Florida is not given, nor are the statements of American authors referred to. Steller's manatee (*Rhytina Stelleri*) is described in a popular way, but the opportunity of giving a good figure of this extinct Sirenian, if that were possible, is not taken. The Cetaceans receive fair treatment, and there are several good illustrations of them.

FIG. 2.—The Musk Ox.

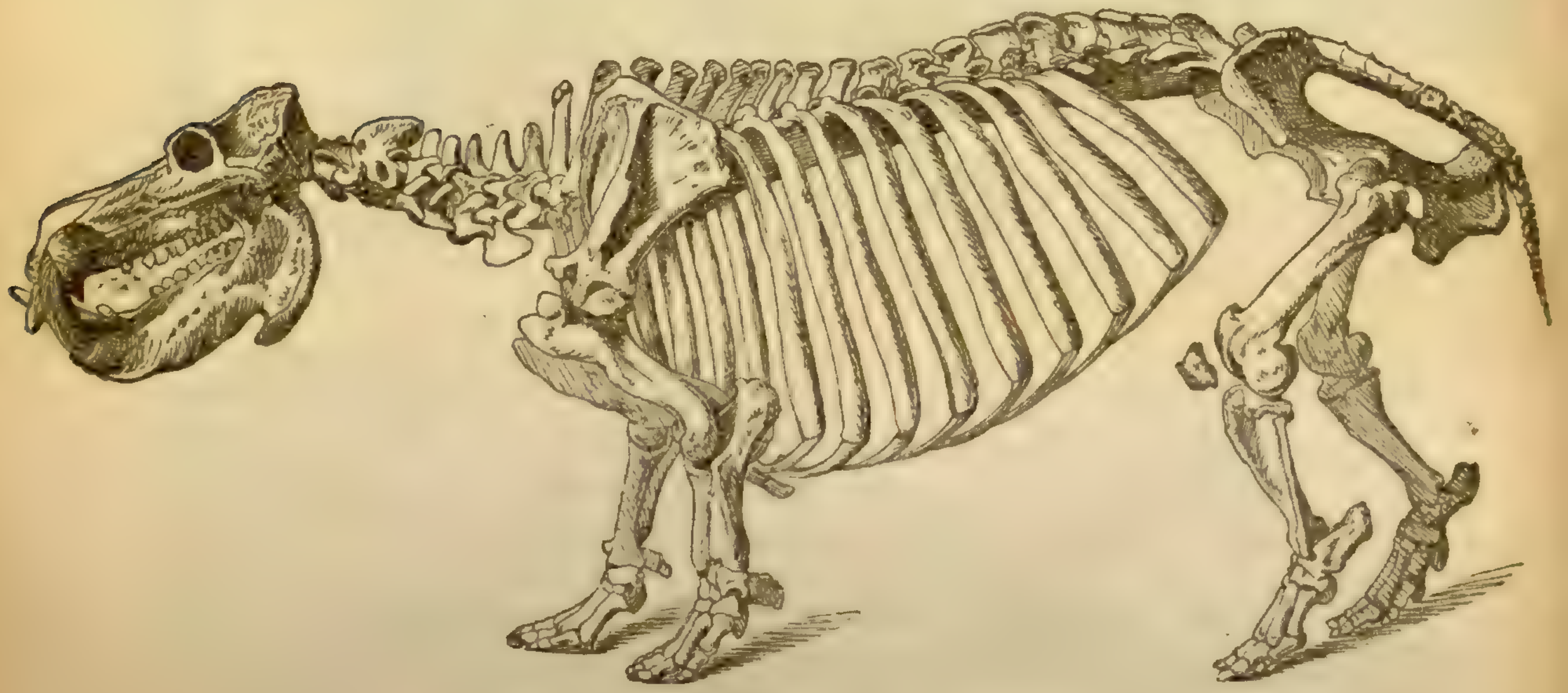

FIG. 3.—Skeleton of the Hippopotamus.

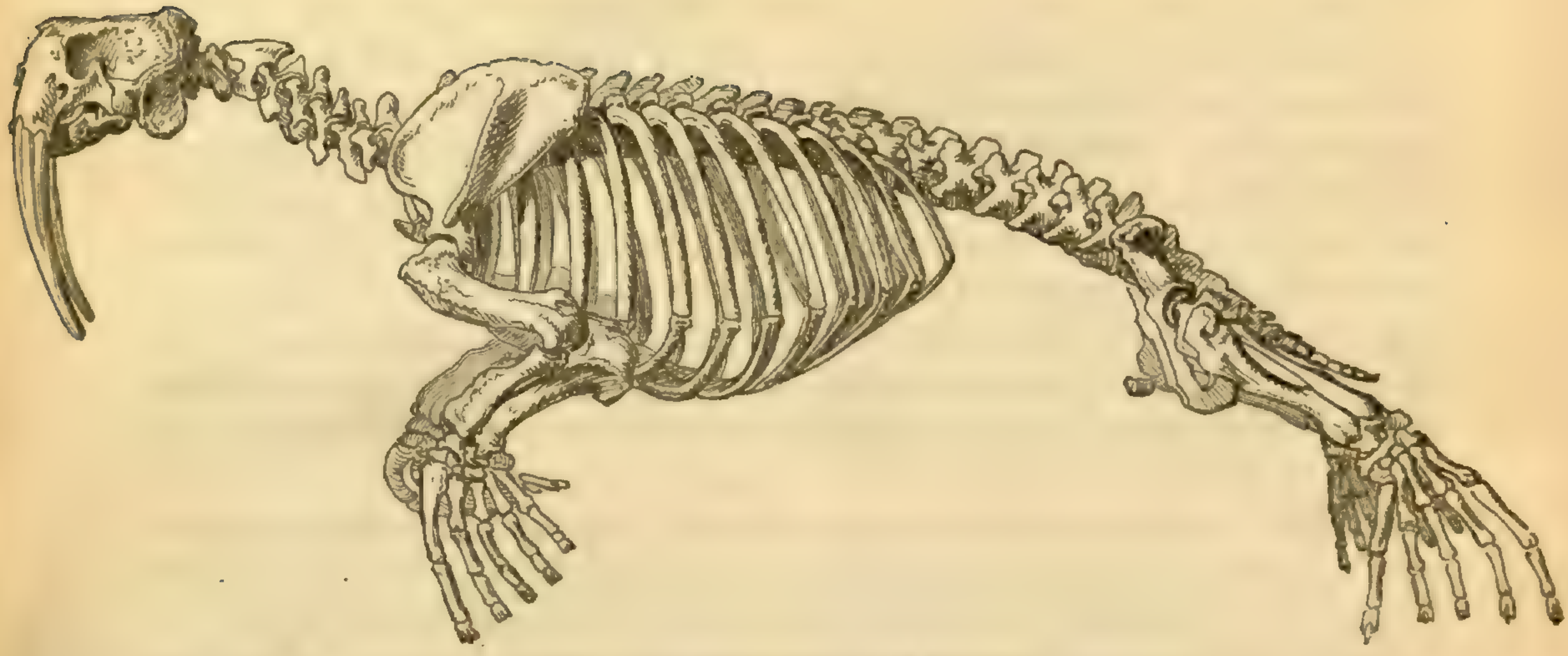

FIG. 4.—Skeleton of the Walrus.

FIG. 5.—The Dugong.

This work has been very highly commended by Darwin, Haeckel, Leuckart and others, and it is the most authoritative popular illustrated work of the kind.

GRAY'S FLORA OF NORTH AMERICA.[1]—All botanists will accept with sincere thankfulness this beginning of the new "Flora." A beginning at the middle, indeed, yet not a "beginning of the end;" but so that the work be done the order of its doing may well be left to his choice who is looked upon with one accord as the only one competent for its proper performance. If a preference might be expressed in regard to it, it would doubtless be that Dr. Gray would see fit to give next a revision of what is by far the most intricate and difficult of all the orders of our flora, viz: the *Compositæ*. No portion of the proposed volumes is more needed by botanists or will be more acceptable, and in none is Dr. Gray more truly the sole authority. As he has recently gone over a considerable portion of the ground in his work for the "Botany of California," this would be all the easier for him.

In looking over the present issue, some peculiarities of arrangement at once attract attention. There are no artificial keys either to genera or species. Under each order the ordinal character is followed by a synopsis of the genera, with concise but essentially complete characters, grouped together not only by sub-orders or tribes (where such exist), but also by minor subdivisions, and under characteristic headings, thus avoiding repetition, and leading most directly to the genus sought. When the genus itself is taken up, only such other details, general remarks and synonymy are given as may be needed to fully supplement the previous description. A comparison with the published volumes of "Torrey and Gray's Flora" will make the improvement of plan manifest, and show the appropriateness of the title which Dr. Gray has adopted. The same synoptical method, however, is not carried out in the treatment of species, though they are similarly grouped under common headings so far as they have essential characters in common. The specific descriptions themselves are full, but without redundancy or needless repetition. Of their technical accuracy and finish it is unnecessary to speak. It may perhaps be questioned whether it would not have been well, at least in the larger genera, to have subjected the species to the same process as the genera themselves. One would imagine that what is best in the one case should be best in the other also. Experience in the use of the book should determine. As compared with the "Manual" the descriptions are much fuller, and yet, even with the additional synonyms, etc., the species occupy on the average but little more space. A synoptical key to the orders has been omitted, doubtless because it will come more properly in the first volume at the beginning of the *Gamopetalæ*, of which we have here only the concluding portion.

[1] *Synoptical Flora of North America*. By ASA GRAY, LL.D., F.M.R.S. and L.S. Lond., R.I.A., Roy. Soc. Upsala, Stockholm, Göttingen; Roy. Acad. Sci. Munich, Berlin, etc.; Corresp. Imp. Acad. Sci. St. Petersburg, etc.; Fisher Professor of Natural History (Botany) in Harvard University. Vol. ii, Part i. Gamopetalæ after Compositæ. New York, Ivison, Blakeman, Taylor & Co. London, Trübner & Co., Ludgate Hill. Leipsic, T. O. Weigel. May, 1878.

Much care has evidently been taken in the selection of the type used for different purposes, and in the general "get up" of the book. It is a satisfaction to see that Dr. Gray has not countenanced, in the writing of botanical names, the methods of punctuation and the disuse of capital letters so generally favored by American zoölogists and entomologists, and which some would force upon our botanists. Whatever may be the rules of punctuation in Latin or in the Continental languages, in the use of the English language the same principles should apply in writing upon botany as upon other subjects. In general, thus far, this has been the case. English-writing botanists, and most English Latin-writing botanists, as well, have been united in their adhesion to English customs in this matter, and it is to be hoped that they will so remain.

The portion of the gamopetalous flora here described includes 1560 native species, belonging to 298 genera. The introduced plants add twenty-six genera and ninety-six species. A comparison with the number of species native to the region covered by the "Manual" (as given in the second edition) makes the probable entire number of phenogamous species in North America to lie between nine and ten thousand. The same conclusion is deduced from the number of polypetalous species as enumerated in the "Bibliographical Index." The mean result from the two comparisons is 9,378 species, so that 10,000 is very probably a closely approximate limit. Of the 298 genera, 120 have only a single species each. By far the most important order is that of the *Scrophulariaceæ*, containing 38 genera and 315 species, the next in order being the *Labiatæ*, with 37 genera, but only 189 species. These orders, with the *Ericaceæ*, *Borraginaceæ*, *Hydrophyllaceæ* and *Polemoniaceæ*, include nearly half of the genera and over three-fifths of the species. The largest genera are *Pentstemon* with 71, *Gilia* with 70, and *Phacelia* with 56 species.

As regards the distribution of this flora, it appears from a very cursory examination that it divides readily into an eastern, a central and a western section. The first may be considered as covered essentially by Gray's Manual and Chapman's Flora, and the last in good degree by the Botany of California. Taking these as a guide, and making to each the additions indicated by the present "Flora," it is found that the eastern division includes 610 native species, of which 130 are peculiar to the Manual, 205 to Chapman's Flora, and 275 common to both. The Botany of California includes 567 species, of which 58 belong also to the Atlantic States. Of the remaining 450 species, 48 are high northern and do not enter the United States, 8 are Mexican and not yet found within our limits, 290 are mainly southern, belonging to the warmer and dryer interior, and 103 are found only in the Rocky Mountains or the cooler region westward to Oregon. Had Greenland been included in the limits adopted by Dr. Gray,

only two other species (*Veronica fruticulosa* and *Gentiana nivalis*) would have been added, and of these the latter is reported from Labrador.

Numerous additions and changes of nomenclature are made in the several sectional floras above mentioned—some of them new, many to be found in previous publications. About 40 species are added to the flora of the southern Atlantic States, chiefly from Florida, and nearly 50 species to the flora of California. The changes to be noted in the flora of the Northern States as given in Gray's Manual (edition of 1868) are less numerous, but some of them are of moment. The following list includes all of the more important:

Phyllodoce taxifolia is referred, with the other species of the genus, to *Bryanthus*—becoming *B. taxifolius*, Gray.

The species of *Azalea* are referred to *Rhododendron*, as was done by Dr. Torrey over fifty years ago, to whom the species are credited. *Rhodora Canadensis* also becomes *Rhododendron Rhodora* of Gmelin (Syst. i. 694, 1796), instead of Don as stated.

The order *Aquifoliaceæ* is excluded as belonging rather to the polypetalous division. This is likewise the case with the closely allied southern order *Cyrilleæ*.

The name *Plantago Rugelii*, Decaisne, is restored for the plant which is referred in the Manual to *P. Kamtschatica*. *P. decipiens*, Barneoud, is also substituted for *P. maritima*, var. *juncoides*, which latter species is not found in the Atlantic States.

The genus *Steironema*, Raf., is restored for the section of that name under *Lysimachia*.

Utricularia striata, LeConte, is referred to *U. fibrosa*, Walter. The questionable species mentioned in the Manual at the end of the genus is made Var. *cleistogama* of *U. subulata*.

Phelipæa Ludoviciana becomes *Aphyllon Ludovicianum*, Gray.

Chelone obliqua, Linn., is added—a bright rose-colored species, ranging from Illinois and Virginia to Florida.

Pentstemon digitalis becomes *P. lævigatus*, Solander.

Gerardia integrifolia, Gray, is *G. lævigata*, Raf., and *G. setacea* (not Walt.) is *G. Skinneriana*, Wood.

Bartsia Odontites, Huds., is added as sparingly naturalized on our northern coast.

The varieties of *Lycopus Europæus* are established as species, viz: *L. sessilifolius*, Gray, *L. rubellus*, Moench, and *L. sinuatus*, Ell.

Pycnanthemum pilosum is made a variety of *P. muticum*.

Calamintha Nuttallii, Benth., is restored.

Monarda clinopodia, Linn., is added, intermediate between *M. didyma* and *M. fistulosa;* also *Physostegia intermedia*, Gray, of Western Kentucky and south-westward.

Stachys aspera, Michx., and *S. cordata*, Riddell, are restored for varieties of *S. palustris*, the var. *glabra* being referred to the former.

Onosmodium molle is made a variety of *O. Carolinianum.*
Lithospermum longiflorum is referred to *L. angustifolium.*
Myosotis palustris, var. *laxa*, becomes *M. laxa*, Lehm.
Cynoglossum Morisoni is transferred to *Echinospermum* as *E. Virginicum*, Lehm.
Heliotropium tenellum, Torr., is to be added as found in Kentucky.
Ellisia ambigua is reduced to a form of *E. Nyctelea.*
Phlox ovata, Linn., is restored for the broad-leaved form of *P. Carolina*, while var. *nitida* is referred to *P. glaberrima*, var. *suffruticosa*, Gray. *P. amœna*, Sims, is substituted for *P. procumbens* (not Lehm.), and *P. Stellaria*, Gray, is added.
Diapensia and *Pyxidanthera* are united with *Galax* and the southern genus *Shortia* to form the order *Diapensiaceæ.*
Calystegia is returned to *Convolvulus*, where our species were originally placed by Linnæus.
The species referred in the Manual to *Bonamia* are transferred (following Benth. & Hook.) to *Breweria*, R. Br., as distinguished from *Bonamia*, Thouars, by the plicate corolla. It is perhaps through oversight that the species are not credited to Benth. & Hook., who refer to the Manual for the three known North American species.
The perennial forms of *Physalis* are referred to *P. Virginica*, Mill., instead of to *P. viscosa*, Linn., and to *P. lanceolata*, Michx., in place of *P. Pennsylvanica*, Linn.
Gentiana detonsa becomes *G. serrata*, Gunner, and var. *linearis* of *G. Saponaria* is kept distinct as *G. linearis*, Fries. The recent discovery of *G. amarella*, var. *acuta*, in Vermont should be noted.
Forsteronia difformis is transferred, with some doubt, to *Trachelospermum*, Lemaire, a genus of Eastern Asia.
Acerates paniculata is referred to *Asclepiodora*, a genus proposed by Dr. Gray for all the later species of *Anantherix*, Nutt., which is restricted to the single species upon which it was founded.
Ligustrum vulgare is inadvertently omitted.
Olea Americana is separated from *Olea*, Tourn., by Benth. and Hook., and carried to the Chinese genus *Osmanthus*, Lour.—*Sereno Watson.*

GRABER'S INSECTS.[1]—The author of this work is Professor of Zoölogy, at the University of Czernowitz, Austria, and is well and most favorably known by his beautiful and elaborate histological researches on the organs of hearing in insects, and other points in their minute anatomy, especially of the digestive canal of orthoptera, &c. The popular work on insects is a comprehensive and original treatise on their anatomy, general and minute, physiology and biology. The illustrations are new and

[1] *Die Naturkräfte.* Eine naturwissenschaftliche Volksbibliothek, xxi, xxii, Band. Hälfte i. Die Insekten, Von DR. VITUS GRABER. München, 1877, 12 mo. pp. 403, 261.

original, and those representing the anatomy and histology of insects are new and valuable. Especial attention is devoted to the mechanics of the appendages as well as the trunk and wings. The nervous system is thoroughly discussed, while the structure and functions of the organs of sight, hearing, touch, smell and taste are treated of at length. The portion on reproduction is not so original as the rest of the book. The second part is devoted to the habits of insects, and is more of a compilation than the first part, the author's *forte* being the anatomy and physiology of insects, his skill in anatomical drawing being of a high order. The work forms the twenty-first and twenty-second volumes of a series of popular works on *Naturkräfte*, a word not easily translated, but the series corresponds to the international science series of the Appletons. The illustrations are excellent and numerous, being a most valuable feature of the work.

RECENT BOOKS AND PAMPHLETS.—Freie Wissenschaft und freie Lehre. Eine Entgegnung auf Rudolf Virchow's Münchener Rede über "Die Freiheit der Wissenchaft im modernen Staat." Von Ernst Haeckel. 8vo, pp. 106. Stuttgart, 1878. From the author.

Notice sur l'Habitat et les Caractères du Macroscincus coctei (Euprepes coctei, Dum. et Bibr.) Par J. V. Barboza du Bocage. 8vo, pp. 12, with photographic plate. Lisbon, 1873. From the author.

Mélange Erpetologiques. Par J. V. Barboza du Bocage. (Ext. do Jorn. de Sci. Math. Phys. e Naturales, Lisboa, 1873.) 8vo, pp. 24. From the author.

Lista de Mammiferos das possessoes portuguezas da Africa occidental e diagnoses de algumas especias novas. Pelo Dr. W. Peters, Director Mus. Zoöl. da Univ. Real de Berlin. (Ext. do Jorn. etc.) 8vo, pp. 5. Lisbon, 1870. From the editor.

Algumas consideraçoes ácerca da industria piscicola em Portugal. Por F. de Brito Capello. (Ext. do Jorn. etc.) 8vo, pp. 9. Lisbon, 1876. From the author.

Entomological Notes vi. By Samuel H. Scudder. (Repr. Bost. Soc. Nat. Hist., Vol. xix, 1877–78) 8vo, pp. 55. Boston, 1878. From the author.

Additions to the Insect-fauna of the Tertiary Beds at Quesnel (British Columbia). By Samuel H. Scudder. (Ext. Geolog. Surv. Canada. Rep't of Progress, 1876–77.) 8vo, pp. 8. From the author.

Psyche. Organ of the Cambridge Entomological Club. Vol. ii, Nos. 45, 46, Cambridge, Mass., Jan., Feb., 1878. 8vo, pp. 97–120. From S. H. Scudder.

Proceedings of the American Association for the Advancement of Science. Twenty-sixth Meeting, held at Nashville, Tenn., Aug., 1877. 8vo, pp. 400. Salem, 1878.

Journal of the Franklin Institute. (Third series, Vol. lxxvi, N o. 2, Aug., 1878.) From the Institute.

Die Reptilien und Fische der Böhmischen Kreideformation. Von Dr. Anton Fritsch. Mit 10 lithographischen Tafeln und 66 Holzschnitten. 4to, pp. 44. Prag, 1878. From the author.

The Journal of the Royal Geographical Society. Vol. xlvii for 1877. 8vo, pp. i–iv, 300, with 14 maps and plates. London, John Murray, 1878. From the Society.

Labyrinthodon Rütimeyeri. Ein Beitrag zur Anatomie vom Gesammt Skelet und Gehirn der Triassischen Labyrinthodonten. Von Robt. Wiedersheim, Prof. in Freiburg i. B. (Abhand. d. Schweiz. Palæont. Gesellsch. Vol v.) 4to, pp. 56, plates 3. Zürich, July, 1878. From the author.

Proceedings of the California Academy of Sciences. Vol. vi, 1875. 8vo, pp. 222, and Vol. vii, part i, 1876, 8vo, pp. 176. San Francisco, 1876–7. From the Society.

Annual Record of Science and Industry for 1877. Edited by S. F. Baird, with the assistance of eminent men of science. 8vo, pp. 480. New York, Harper & Brothers, 1878.

First Annual Report of the United States Entomological Commission for the year 1877, relating to the Rocky Mountain Locust and the best method of preventing its injuries and of guarding against its invasions; in pursuance of an appropriation made by Congress for this purpose. With maps and illustrations. 8vo, pp. 477, and appendices 294. Washington, 1878. From the Department of the Interior.

Zoölogischer Anzeiger. Herausgegeben von Prof. J. Victor Carus in Leipzig. I Jahrgang. Nos. 1–3. July, 1878. 8vo, pp. 60. Verlag von Wilh. Engelmann, Leipzig. Jährlich erscheinen 25–26 Bogen. Price 6 marks. From the editor.

Tidskrift for Populære Fremstillinger af Naturvidenskaben, udgivet af C. Fogh, C. F. Lütken og Eug. Warming. Femte Raekke, Femte Binds, Tredje Aargang. 8vo, pp. 161–240. Kjöbenhaven, 1878. From the editors.

The Botanical Gazette, August, Sept., 1878, Vol. iii, No. 3. 8vo, pp. 65–72. J. M. & M. S. Coulter, Editors and Publishers, Logansport, Ind., 1878.

The American Journal of Microscopy and Popular Science. Vol. iii, No. 7, New York, July, 1878. From the editor.

Proceedings of the Royal Geographical Society, Vol. xxii, Nos. 2, 3, March and May, 1878. 8vo, pp. 67–229. London. From the Society.

Matériaux pour l'Histoire Primitive et Naturelle de L'Homme. Revue Mensuelle Illustrée dirigée par M. Emile Cartailliac avec le concours de MM. P. Cazalis, Fondouce et Chantre. 2e Serie, Tome ix, 1878. 4e et 5e livraisons with map. 8vo, pp. 147–248. Toulouse, 1878. From the editors.

The Popular Science Monthly, August, 1878, No. lxxvii. Supplements xv, xvi, July and August, 1878, 8vo. New York, D. Appleton & Co. From the editors.

Le Naturaliste Canadien. Redacteur, M. L'Abbe Provancher. Vol. x, No. 6, June, 1878. Cap Rouge, Prov. de Quebec, Canada. From the editor.

Proceedings of the Academy of Nat. Sciences of Phila., 1878. 8vo, pp. 217–264. From the Society.

La Tempestad de los Dias 7 y 8 Abril de 1878. Estudia Meteorologico por el ingeniere civil Vicente Reyes. 8vo, pp. 12 and chart. Mexico, 1878. From the author.

Addenda to etiological views expressed in a paper "On the mechanical genesis of tooth-forms." By J. A. Ryder. 8vo, pp. 3. (Dental Cosmos, Repr.) September, 1878. From the author.

The Bee-keepers' Magazine. Vol. vi, No. 8, August. 8vo, pp. 154–176. New York, A. J. King & Co., 1878.

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GENERAL NOTES.

BOTANY.

The Grasses of Mexico.—M. Eugéne Fournier has raised the number of species of grasses from eighty-eight, as reported in Kunth's Synopsis, to 638. He finds that sixteen species extend from the shores of the ocean to the elevated plateaux. He also finds, as he had previously done in regard to the ferns, that many species grow on both slopes of the Cordilleras. Out of 162 species common to Mexico and other regions, only two grow in California. East of the Rocky Mountains, Texas has thirty-two species, one grows in the prairie region, and the other fifty-nine United States species are almost confined to Florida, Georgia and South Carolina, scarcely any occurring in Louisiana, Mississippi, or Alabama. The cause of this peculiar distribution may be found in the direction of certain winds, especially the whirlwinds

noticed by M. F. F. Hebert, which, descending upon the Gulf of Mexico by the valley of the Rio del Norte, strike the north of Florida, and then sweep northward along the eastern slope of the Alleghanies.

By their geographical distribution and botanical characters, the Mexican *Gramineæ* are divided very clearly into two groups—those which are peculiar to Mexico or common to it, and the Andean region, or to more northern regions, are generally distinguished by the slenderness and lightness of their leaves and panicles; those which spread into the tropical region, on the contrary, are remarkable by their size, and the amplitude of their organs of vegetation and of their inflorescence. The former generally inhabit dry and mountainous localities; the latter the banks of rivers, and moist places; some of them extend from the United States to the Argentine Republic through 70° of latitude (*Comptes rendus* June 10, 1878).

THE CONNECTION OF BACILLI WITH SPLENIC FEVER.—Doubt having been thrown on the supposed fact that splenic fever is caused by *Bacillus anthracis*, Dr. Ewart has published in the Journal of Microscopical Science, the result of his studies. In the spleen of a mouse which had just died of the disease after being inoculated with the plant, the *Bacilli* were found rod-shaped and motionless. In a few hours, the temperature being 30° C. (= 91° F.), many of these rods began to move actively in a wriggling manner, and after continuing in this motile state for some time, they either suddenly or gradually settled down again, and then lengthened out into spore-bearing filaments. A mouse inoculated with the spores thus obtained, died in forty-eight hours of splenic fever. The spores are formed in a similar manner to the Chlamydospores of *Mucor*.

By Koch and some other observers, these spores have been described as germinating at once, and reproducing the rods, but Dr. Ewart found that this process was often preceded by the division of the spore into four sporules, all of which closely adhere at first, but ultimately become free and settle down in colonies. The sporules then germinate and produce the rods. The most important morphological conclusion which Dr. Ewart draws from these other observations is that the *Micrococcus*, *Bacterium* and *Bacillus* forms, and the spore-bearing hyphæ are phases of the same life history. His experiments have been confirmed by other observers.

ASCENT OF SAP IN TREES.—A theory has lately been propounded, and thoroughly worked out by Joseph Böhm, which is said by a writer in *Der Naturforscher*, according to *Nature*, to be characterized by good consistency, and offers perhaps a more satisfactory explanation of the phenomenon than any that have been referred to. It is based, like the osmotic theory, on the cellular structure

of all sap-conducting plants, and it attributes an important *rôle* to the *elasticity of the cells*. "When the surface-cells of a plant," says M. Böhm, "have lost a portion of their water through evaporation, they are somewhat compressed by the air-pressure. Like elastic bladders, however, they tend to take their original form. This of course is only possible by their drawing in either air or water from without. Since, however, moist membranes are little penetrable by air, the cells draw from cells farther in a portion of their liquid contents. These again borrow from their neighbors further down, which contain more water, and so on, either to the extreme root-cells or to those parts of the stem which are supplied with water from below through root-pressure."

To illustrate the action, M. Böhm constructed an artificial cell-chain. A funnel closed by a bladder represented the evaporating leaf; to it were connected below several glass tubes about two ctm. wide, closed at one end with a bladder, and joined together in series by means of thick walled caoutchouc tubing. In consequence of the evaporation, the membrane which closes the funnel mouth is bent inwards, and when it has reached a certain tension, water is sucked into the funnel out of the next lower cell, which covers its loss in like manner. Manometers, connected with certain cells of the apparatus, indicate the amount of suction at different heights. To avoid fouling of the membranes, carbolic acid was mixed with the distilled water in the cells. Since bladder membranes, with a not very great height of liquid column over them, admit passage of water by filtration, these artificial cell-chains (it is pointed out), must act much more imperfectly than the sap-conducting cells placed over one another in living plants, which cells, by reason of their narrow aperture, retain their liquid column by capillary attraction.

It is shown that this theory is in harmony with sundry phenomena which are contradictory of the imbibition theory.

Austin's Musci Appalachiani.—Supplement I to *Musci exsiccatæ*, containing one hundred tickets of specimens of mosses collected mostly in the eastern part of North America, by Col. F. Austin, will interest botanists. The author proposes to publish additional supplements to both the *Musci* and *Hepaticæ* which have been issued, to comprise one hundred sets of from ten to fifty specimens each. The specimen illustrating the first supplement are to be had for $6 a set.

Botanical News.—Trimen's *Journal of Botany* for July contains a paper on the structure and affinities of *Characeæ*, by A. W. Bennett. A summary is given of Dr. Kienitz-Gerloff's exhaustive study of the development of the capsule of *Phascum cuspidatum*. The *Botanischer Zeitung* contains papers by H. Hoffmann on experiments in culture, and by J. Sachs "on the history of the mechanical theory of growth of organic cells."—The *Annales des*

Sciences Naturelles contains articles by A. Guillaud on the comparative anatomy and development of the stem in Monocotyledons, and by E. Warming on the ovule, and by Van Tieghem on the *Mucorineæ* (third paper).

ZOÖLOGY.[1]

TWO-HEADED SNAKES.—In reference to the two-headed snakes mentioned on pages 264 and 470 of the NATURALIST of the present year, I would say that there exists another specimen without locality in the collection of the Lyceum of Natural History of Williams College. In the same collection is a specimen of a five-legged frog (*Rana sp.*) from Rochester, N. Y. In this the fifth leg is situated between the two posterior pairs and just above the anus, and is in all respects as perfect as the two normal ones. The specimen is about as large as the average *R. palustris*, and, if I remember rightly, belongs to that species.

In "An Essay on the Natural History of Guiana," London, T. Becket and P. A. DeHondt, 1769, the author discourses upon the *Amphisbænæ* of that country, stating that they have a head at each extremity, and "yet, except these there is no animal in nature that is thought to have two heads;" and in a foot note on the same page (214) says: "I have received a particular description of a monstrous *Amphisbæna* found near Lake Champlain in North America by an officer in the American service, who, with one of his Majesty's draughtsmen, was sent during the late war to make a survey of that lake. They were previously informed by the Indians of the existence of these serpents, one of which they killed near a bay in Lake Champlain, which in the maps of that country has been since called Double-headed-snake bay. This serpent was a small one of the kind, it being about fifteen inches in length and largest near the middle, terminating in a slender tail. The body at the other end divided into two necks of equal size, to each of which was joined a perfect head, with two eyes, a large mouth and throat, a forked tongue, with teeth of the same species with those of the rattlesnake. The color of the heads was dark brown, and the scales on the back and side were variegated of dark and reddish-brown colors, in magnitude and disposition resembling those of the rattlesnake. This serpent was a perfect monster, of whose existence I should strongly doubt, did I not think the veracity of the gentlemen from whom I have this information, and by whom it was unquestionably killed, unquestionable."

The frontispiece of the same volume gives a figure of this same specimen, drawn by M. Park, and bearing the inscription "*Amphisbæna* or double-headed snake. This snake was found near

[1]The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

Lake Champlain, in America, in the year 1761, by Lieut. Moses Park."

The figure has a lighter U-shaped mark upon the heads, and a dorsal row of rectangular spots alternating with a similar lateral row on each side, reminding one strongly of the arrangement of the squares on a checker board.—*F. S. Kingsley.*

Mimetic Coloring in Tadpoles.—Recently I came across a very pretty instance of imitative coloration in some tadpoles caught in a weedy pool in Cold Spring, New York. The largest tadpoles are an inch and three-quarters long, bodies half an inch long, and widest part of tail half an inch. The hind legs are visible, but very small. They are greenish above with black markings, and have minute golden spots about the eyes and along the sides; beneath they are silvery white. Their tails are orange-red for more than two-thirds the length, and the color deepens toward the end and along the margin. There are black spots and irregular lines, which are very distinct, on the margin. The largest tadpoles are more brightly and distinctly colored.

In the same pool there is a plant (*Ludovidgia palustris*), whose lower leaves, which are under water, are *exactly* the same color as the tails of the tadpoles. The brightest ones are generally full of holes. The tails of the tadpoles also resemble the leaves in width and shape. The resemblance of color is so striking that a friend, who is not on the lookout for analogies, pointed out a leaf as a tadpole in the vessel where they both were placed. Some that I have had in a soup plate for several days have become very much paler, both the green and red, and the spots are almost invisible. These tadpoles show how early Batrachia begin to adapt themselves to their color-surroundings.—*Sarah P. Monks.*

Fresh-water Mussels vs. Ducks.—In the Naturalist for July I notice a communication from Mr. R. Ellsworth Call, in which he mentions that he has been informed that Mr. A. F. Gray has the foot of a water-fowl to which is attached a bivalve shell. Several years ago while shad-hatching for the United States Fish Commission, on the Pamunky river, near White-house landing, Va., I noticed great quantities of Unios, and in remarking on it to a gentleman residing there, was informed that it was not possible to raise ducks in that locality on their account, for at low water the ducklings were liable to be caught by the mussels and held until drowned by the rising tide.

This story was afterward confirmed by the Pamunky Indians, who live on an island below White-house, and who, with every facility for raising large quantities of ducks, do not keep them.—*Fred. Mather, Newark, N. J.*

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—The American Association for the Advancement of Science, meeting this year in the very heart of our antiquarian region, was favored with many valuable papers. The character of these communications is improving from year to year, and less of wild speculation characterizes the discussions. To facilitate interchange among students, we append a list of papers with the addresses of the authors:

Ancient Mounds in the vicinity of Naples, Scott county, Illinois, J. G. Henderson, Winchester, Ill.; Ancient Names, Geographical, Tribal and Personal, in the Mississippi valley. same author; Description of two Stone Cists, discovered near Highlands, Ill., by Arthur Oehler, of Highlands, Ill.; Description of a Cliff-house in the cañon of Mancos river, Colorado, Wm. F. Morgan, Rochester, N. Y.; Remarks on the Ruins of a Stone Puéblo on the Animas river, New Mexico, with a ground plan, Lewis H. Morgan, Rochester, N. Y.; Observations on the San Juan River district as an important ancient seat of Village Indian Life, same author; On the Sources for Aboriginal History of Spanish America, by A. F. Bandelier, of Highland, Ill.; Remarks on the Archæology of Vermont, by G. H. Perkins, of Burlington, Vt.; Remarkable Burial Custom from a Mound in Florida; The Cranium utilized as a Cinerary Urn, Henry Gillman of Detroit, Mich.; Description of a Glazed Earthen Vessel, taken from a Tumulus in Florida, same author; Evidence of Cannibalism in a Nation before the Ainos in Japan, by E. S. Morse, of Japan; An Atlas of North American Antiquities, by O. T. Mason, of Washington, D. C.; North American Indian Synonomy, same author; Ancient Pottery from Chiriqui, Central America, by O. C. Marsh, of New Haven, Connecticut; On the Anatomical Peculiarities by which Mound-builders' Crania may be distinguished from those of the Modern Indian, by W. J. McGee, of Farley, Iowa; Exhibition of Pre-historic relics from Missouri, by A. J. Conant, of St. Louis; An Account of an Exploration of a Walled Town of the Mound-builders of the Cumberland valley, by F. W. Putnam, of Cambridge, Mass.; On the Discovery of a Human Skull in the Drift near Denver, Colorado, by Thomas Belt, London, England. We can but feel that the American Association is the proper meeting for our American anthropologists to patronize, not to the disparagement of local and State societies, but as a supplementary means of better acquaintance among workers in all parts of our country.

The May number of the *Journal* of the Anthropological Institute contains the following papers: On Flint Implements from Egypt; Discoveries at Cissbury; Collection of Andamanese and Nicobarese objects; The Ethnology of Motu; Palæolithic Im-

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

plements in the Valley of the Axe; Notes on the Zaparos, and the President's Address. Especial interest attaches to the detachable spear-heads, or harpoon-heads on plates xii, xiii, xiv, xv, as well as to the many-pronged fish or bird-spears, because these objects resemble so closely those found in various parts of America. Referring the matter to Mr. Frank H. Cushing, of the National Museum, we received the following reply: "Three kinds of harpoon-arrows are found among our North American collections. A very rude form is used by the McCloud River Indians in catching salmon. Another entirely typical, highly finished, and as often pointed with native copper as with bone or ivory, is employed by the North-west Coast Indians for the same purpose. A third common to the Alaska Eskimo, and entirely resembling the formidable fishing spears of the Andaman Islanders." Without drawings it is impossible to convey the resemblance between the loose headed implements of Andaman and Nicobar and those of our American continent.

The Smithsonian Institution has lately published through the Government Printing Office four pamphlets relating to archæological subjects. They are reprints from the forthcoming Smithsonian Report for 1877. We can only give the titles: Aboriginal Structures in Georgia, by Charles C. Jones, Jr.; On a Polychrome Bead from Florida, by S. S. Haldeman; The Stock-in-trade of an Aboriginal Lapidary, by Charles Rau; Observations on a Gold Ornament from a Mound in Florida, by the same.

A writer in the *Nation* for July 25th gives a very graphic description of the lessons of the Bannock war. A scientific journal cannot discuss the merits of the amount of culpability resting on our government for the war. A very interesting illustration of the aid which ethnology may furnish to politics is given in a supplementary note on page 57, evidently from the same pen. "The word Bannock is a corruption for Pannaiti [Panaiti?] by which name the people know themselves, and means 'Northerners,' they, in fact, dwelling the furthest north of all the tribes composing a great linguistic stock which once occupied nearly the whole of the interior basin between the Rocky Mountains and the Sierra Nevada, and crossed over both those ranges at several points in the south of California, reaching the Pacific. A large part of the whole family has in the past been styled 'Shoshoni' or 'Snakes,' after one of its prominent divisions. The Bannocks and Paviotsos are hereditary enemies. The Umatillas, Cayuse, and Walla-Wallas are of the Sahaptin family, whose immemorial feud with the Shoshones would induce them to attack rather than to join the Bannocks."

Prof. De Hass has been spending some months in Washington taking advantage of the fine collections and libraries there to add to the value of his course of lectures on archæology. He has been so fortunate as to trace in the uplands of Pennsylvania,

Maryland and Virginia abundant evidence of ancient hill tribes inhabiting these regions burying their dead in rude cists in stone cairns.

FOREIGN.—The department of ethnology now called Demography, represented in England by Francis Galton and in France by M. Bertillon, is becoming more and more popular in its character. A Congress of Demography was held at the Trocadero Palace from July 5–9, and discussed the following topics: Census of Population; Registers of Population; Organization of Statistics; Registration of Births and Deaths, &c. Dr. Daniel Wilson, of Toronto, said at the Buffalo meeting of the American Association that no country in the world afforded a better opportunity of submitting racial problems to the test of figures than our own.

Doctor E. Bessels is publishing, in German, a work on his researches in Greenland. About thirty pages will be devoted to the Greenland Eskimo and will be most beautifully illustrated. By the way, will some one tell us the origin of the word *Keralit*, used by old writers on the Greenland Eskimo? Is it a corruption of the Danish *Skræling*?

Dr. Alexander Ecker has published in Braunschweig a quarto pamphlet of twenty-one pages entitled: Ueber abnorme Behaarung des Menschen insbesondere über die sogenannten Haarmenschen. Gratulationschrift Herrn Carl Theodor von Siebold zur Feier seines 50 jährigen Doctorjubiläums am 22 April, 1878, dargebracht von Alexander Ecker. A few of the illustrations appeared in a late number of *Archiv*, but in its present form the treatise forms one of the most entertaining anthropological articles of the year. The same author has published in Freiburg a quarto pamphlet on Lapland and the Laplanders.

Archivo iper L'Antropologia, 1878. Part I contains the following original papers: Suture anomale dell' osso malare in sei crani umani; Studii intorno ai crani papuani; Selci lavorate dall' uomo in alcuni depositi quaternari del Perugino; Note antropologiche sulla Sardegna; Fisiologia e psicologia; Notizie intorno ai Djelma o Baduvi ed ai Tenger; Su nove crani metopici di razza papua, osservazioni intorno all' influenza del metopismo sui caratteri di razza del cranio.

Professor H. Fischer, of Freiburg, contributes another of his valuable papers on Mineralogical Archæology to Mittheilungen der Anthropologischen Gesellschaft in Wien, 1878. Nos. 1 and 2.

The third part of *Revue d'Anthropologie* for July contains an unusually rich collection of material, but we have space only for the contents: Anatomie Comparée des circonvolutions cérébrales —Le Grand Lobe Limbique et la Scessure Limbique dans la Série des mammifères, by Paul Broca; Essai de Classification des Races Humaines Actuelles, by Paul Topinard. The rest of the *Revue* is taken up with a rèsumé of anthropological matters in various parts of the world. Of M. Broca's eminent services in

the field of cranio-cerebral topography we have frequently spoken. The accompanying table furnishes an idea of M. Topinard's classification:

CLASSIFICATION OF HUMAN RACES.

Hair with circular section (straight),	Dolicho,			Esquimaux.
	Brachy,	Rouge,		Red-skins.
		Olive,	America,	Mexicans.
				Peruvians.
				Guaranis.
				Caribs.
		Yellow,	Asia,	Samoyedes.
				Mongols.
				Malays (Mongolians).
Hair with intermediate cross section (waved or frizzed),	Dolicho,	Blond,		Cimmerians.
				Scandinavians.
				Anglo-Saxons.
		Brown,		Mediterraneans.
				Semites.
		Black,		Australians.
				Indo-Abyssinians.
		Red,		Foulbes.
				Barabras rouges.
	Brachy,	Blond,		Fins.
		Chestnut,		Celts.
				Slavs.
		Brown,		Iranians.
Hair with elliptical section (wooly),	Dolicho,	Yellowish,		Buschmen.
		Black,	Oceanica,	Papuas.
			Africa,	Caffres.
	Brachy,			Negritos.

GEOGRAPHY AND TRAVELS.[1]

British Association. Sir Wyville Thomson's Address.—At the meeting held at Dublin this year, Sir Wyville Thomson on taking the chair of the Geographical Section began his address with a reference to the return of Mr. Stanley as one of the great events of the year 1877. He expressed admiration of the iron will and daring intrepidity which had successfully carried Mr. Stanley through his African exploration. Although in reading Mr. Stanley's narrative we may be forced to regret some of the dark scenes by which his terrible march was checkered, still no one who has not himself had some dealings with savages can fully understand how entirely the action of a leader, solely responsible for the lives of his party, must be guided in every emergency by considerations which he alone is in a position to weigh. The report, in eighteen volumes (after seventeen years' labor) of the circumnavigating voyage of the Austrian frigate *Novara* was another of the scientific events of the past year. He also referred to the voyage of the Italian corvette *Magenta*, the sounding voyages of Capt. Belknap in the *Tuscarora*, the *Hassler* expedition of the elder Agassiz, the tentative cruises of the British gunboats *Lightning* and *Porcupine*, culminating in the *Challenger* expedition, the expeditions to observe the transit of Venus, the several Swedish expeditions to the Spitzbergen sea, and the Arctic voyage of the *Alert* and *Discovery*, the account of which by Sir George Nares it was impossible to read without a feeling of regret that the devoted little band had attempted what was so

[1] Edited by Ellis H. Yarnall, Philadelphia.

hopeless, and at the same time a conviction that if their task had been practicable by human skill and bravery it must certainly have been accomplished. Speaking of the large contributions of Prof. Mohn and Prof. Sars, of Norway, to our knowledge of the distribution of temperature and the course of ocean currents, he remarked that Prof. Mohn spoke highly of the service rendered by Negretti and Zambra's new reversing thermometer, an instrument so constructed that by a simple mechanical arrangement the temperature might be registered at any given depth irrespective of any number of zones of temperature, higher or lower, through which the instrument may have passed in descending. In the *Challenger* the want of such a thermometer was greatly felt, for in the Arctic and Antarctic seas the coldest layer is frequently on the surface, and a warmer belt intervenes between it and a bottom stratum. At a depth averaging perhaps 500 fathoms we arrive at a temperature of 40° Fahr., and this may be regarded as a kind of neutral band separating the two layers. Above this band the temperature varies over different areas; beneath it the temperature almost universally sinks very slowly and with increasing slowness to a *minimum* at the bottom. Speaking generally, it may be said that the trade winds and their modifications and counter currents are the cause of all movements in the stratum above the neutral layer. One of the most singular results of late investigations is the establishment of the fact that all the vast mass of water, often upwards of 2,000 fathoms in thickness, below the neutral band is moving slowly to the northward, that, in fact, the depths of the Atlantic, the Pacific and the Indian oceans are occupied by tongues of the Antarctic sea, preserving in the main its characteristic temperatures. The immediate explanation of this very unexpected phenomenon seems simple. For some cause as yet not fully understood, evaporation is greatly in excess of precipitation over the northern portion of the land hemisphere, while over the water hemisphere, particularly its southern portion, the reverse is the case. Thus one part of the general circulation of the ocean is carried on through the atmosphere, the water being raised in vapor in the northern hemisphere is hurried by upper wind currents to the zone of low barometric pressure in the south, where it is precipitated in the form of snow or rain. Time would not allow him even to allude to the interesting results obtained from the determination of the density of sea water from different localities and depths. He must, however, say a few words as to certain additions which have been made to our knowledge of the regions round the North and South Poles. The question whether it is possible that there can be at all times or at any time anything in the form of an open Polar sea seems now to be virtually settled, and in the most unsatisfactory manner imaginable. From the observations of Count Wilezek in 1871 and Weyprecht and Payer in the follow-

ing year, and from those of Dr. Hayes in 1861 and Capt. Nares in 1875–6, it is evident that the Polar basin is neither open sea nor continuous ice, but a fatal compromise between the two; and there seems now to be only two plans, one nearly as hopeless as the other, to choose between in any future attempt—either to establish permanent stations, as proposed by Lieut. Weyprecht and already initiated at one point by Capt. Tyson and Capt. Howgate, and to seize the opportunity of running north in early autumn from the station where the sea appears most open, or to run as far north as possible, at enormous expense, with a great force of men, and abundance of provisions, and paraffine oil, and push northwards during the Arctic winter by a chain of communicating stations, with ice-built refuge huts.

But little progress has been made during the past quarter of a century in the actual investigation of the conditions of the Antarctic regions. From information derived from all sources up to the present, it may be gathered that the unpenetrated area of 4,700,000 square miles surrounding the South Pole is by no means a continuous continent, but consists much more probably partly of comparatively low continental land, and partly of a series of continental islands bridged between and combined and covered to a depth of about 1,400 feet by a continuous ice cap. Several considerations appeared to him to be in favor of the view that the area round the South Pole is broken up and not continuous land. We have not only the presumed effect of the transfer of warmer water to the southwards, but in the *Challenger* they had been able to detect its presence by the thermometer in high southern latitudes. It seems that all the icebergs are originally tabular, the surface being perfectly level and parallel with the surface of the sea, a cliff of about 230 feet high bounding the berg. It seems probable that under the enormous pressure to which the ice is subjected a constant system of melting is going on, the water passing down by gravitation from layer to layer until it reaches the floor of the ice sheet, and finally working out channels for itself between the ice and land. He could scarcely regret that it was utterly impossible for him on this occasion to enter into details with regard to the relations of the abyssal fauna. He must admit that the relations of the abyssal fauna to the fauna of the older tertiary and newer mesozoic periods, though much closer than those of the fauna of shallow water, were not so close as he had expected them to be; but he felt that until the zoölogical results of several later voyages, and especially those of the *Challenger*, should have been fully worked out, it would be premature to commit himself to any generalizations. Within the last decade the advance of knowledge bearing upon the physical geography of the sea has been confusingly rapid, so much so that at this moment accumulation of new material has far outstripped the power of combining, and digesting, and methodizing it. Steady progress is, however,

being made, and he trusted that in a few years our ideas as to the condition of the depths of the sea may be as definite as they are with regard to regions to which we have long had ready access. —London *Times.*

THE ARABIAN DESERT OF EGYPT.—Dr. G. Schweinfurth writes from Cairo, on the 18th of June, to the London *Athenæum* an account of his visit to the desert region lying between the Nile and the Red Sea. He started from a village near Atfih, on the Nile, on March 29th, and, taking a circuitous route, in the course of which he examined, more or less minutely, fifty-five wadis, returned to the Nile opposite to the town of Siut, on June 9th. Whilst he found remains of Roman settlements, neither inscriptions nor ruins indicate any knowledge of this region by the ancient Egyptians. The orographical and hydrographical features of this territory, to the east of the Nile, are far more varied than might have been expected. Every wadi has its own physiognomy. The rocks may belong to the same geological formation, but they vary exceedingly in contour and configuration. The wadis wind about in a curious manner, sloping down gently or steeply; the vegetation met within them is sometimes sporadic, at others ephemeral or continual; the animal world, too, contributes to impress a character upon each of the two hundred principal wadis which are met with in this small corner of North-eastern Africa.

MICROSCOPY.[1]

NATIONAL MICROSCOPICAL CONGRESS—This Convention, a call for which had been published by the Indianapolis Lyceum of Nat. Hist., assembled at Indianapolis on Wednesday morning, August 14th. About sixty members were in attendance, representing fifteen microscopical societies in different parts of the country. Rev. A. B. Hervey was appointed chairman, and H. F. Atwood, secretary. Addresses of welcome were made by Mayor Caven and Dr. O. Evarts, and responded to by the chairman. Regular organization was then effected by the election of the following officers: President, Dr. R. H. Ward, of Troy; vice-presidents, Prof. J. E. Smith, of Cleveland, and Dr. W. W. Butterfield, of Indianapolis; secretary, H. F. Atwood, of Chicago; treasurer, Dr. J. B. Marvin, of Louisville. Four days were occupied with the meetings except Friday afternoon, which was devoted to a railway excursion. On Friday evening a soirée was given at the court house, which was largely attended by citizens. Owing to the large attendance and the limited number of instruments, no effort was made to classify the objects, and the exhibition was of altogether a popular character. On the last day of the meetings a special committee, which had been previously appointed, reported in favor of organizing permanently under the name of the "American Society of Microscopists," with a membership

[1] This department is edited by DR. R. H. WARD, Troy, N. Y.

open to all persons interested in microscopical science, and with meetings to be held annually at places selected during the previous meeting. After much discussion and no little difference of opinion as to radical points, the plan was adopted as reported, and Buffalo fixed upon as the place of meeting for next August. The following officers were unanimously elected for the first year: President, Dr. R. H. Ward, of Troy; vice-Presidents, S. W. Dennis, of San Francisco, and C. M. Vorce, of Cleveland; secretary, Dr. H. Jameson, of Indianapolis; treasurer, H. F. Atwood, of Chicago. The president-elect insisted upon declining election on the ground of having been presiding officer of the Congress, but finally withdrew his resignation. During the meeting papers were read on the following subjects, interesting discussions being drawn out by many of the papers:

"Limit of accuracy attainable in measurements with the microscope," by Prof. Wm. A. Rogers, of Cambridge. "Some new forms of mounting," by C. C. Merriman, of Rochester. Abstracts of these two papers will be published in a succeeding number.

"Formulæ of objectives," by W. H. Bulloch, of Chicago. The construction of several modern lenses of large immersion aperture was given in diagrams constructed from the lenses themselves, with results remarkably close to those formerly obtained by tracing the light mathematically through the objectives according to the data furnished by the makers.

"Angular aperture," by Dr. G. E. Blackham, of Dunkirk, N. Y. This paper gave a full review of the literature of the subject, limited angular aperture to the angular distance of the outside rays of the widest pencil of light, which the object glass could gather up and bring to a focus, with the formation of a well defined image of the object, and insisted upon the superiority, for all purposes, of well constructed objectives of extremely wide angle.

"Angular aperture defined," by Prof. Romyn Hitchcock, of New York. In order that the term angular aperture should mean something definite, and to avoid ambiguity and misunderstanding in future discussion on the subject, it was proposed to adopt a definition of the term which, right or wrong, should be recommended to the microscopists of the country as a convenient and uniform usage. The triangle method was proposed for general adoption, considering the angular aperture of a microscope objective to be the angle of the apex of a triangle having a base equal to the available diameter of the front lens, and a height equal to the actual focal length (working distance), measured in air for a dry lens, and in the fluid employed for an immersion, the collar being adjusted for the most perfect definition in every case. While nearly all the members seemed to be personally in favor of the usage proposed, a motion that the congress should attempt to settle the question by requesting its general adoption met with so much opposition that it was withdrawn.

"Mechanical fingers," by C. M. Vorce, of Cleveland. In this paper the mechanical finger was spoken of as a kind of stage forceps adapted to objects too small and fragile for ordinary forceps, and as an important accessory for the microscope, even as a means of study of minute forms and to those who do not wish to mount objects. Those forms of finger were described which are attached to the objective or to the movable stage, and the home manufacture of them recommended as easy and effective. Their efficiency is greater in proportion to the greater number of movements of the stage and sub-stage. The apparatus should be furnished with a variety of points for different kinds of work, varying from a fine mouse-whisker to a split point of whalebone or quill.

"Microscopical study of the ashes of leaves," by Dr. R. H. Ward, of Troy, describes the method by which leaf ashes may be prepared so as to preserve much of the structure of the leaf. The books speak of the siliceous residue of the leaves of the grasses, but many other leaves are equally available. Leaves of trees are generally used with more success than those of herbs, and they should be gathered late in the summer. A piece of dry leaf is laid on a strip of platinum foil or thin mica, covered with mica or a cover-glass to prevent curling up, and carefully heated over an alcohol lamp or Bunsen burner until the organic matter is slowly burned out and the mineral matter, or ash, remains undisturbed. This is then dropped on to a slide, wet with turpentine, and very carefully mounted in soft balsam. If slightly crushed in mounting, or containing a trace of carbon at some point, the value of the object is often increased. These preparations can be made with great ease and rapidity, and show the construction of the parenchyma, veins, epidermis, stomates and hairs with great beauty and distinctness. In this way was prepared a slide of leaf ashes which was recently sent through the circuits of the Postal Club and which excited an unexpected amount of interest and correspondence.

"Classification of algæ," by Rev. A. B. Hervey, described the systematic arrangement of sea weeds by means of their peculiarities of reproduction, and showed how completely our knowledge of the subject is due to the microscope. The writer urged the more frequent preparation, for use and for exchange, of series of slides illustrating typical species in groups studied by specialists in natural history.—(*To be Continued.*)

MICROSCOPICAL DIRECTORY.—The fullest list of American microscopists yet published will be found in the "Naturalists' Directory for 1878," published by S. E. Cassino, Salem, Mass.

EXCHANGES.—Lake Michigan diatoms mounted or raw material, also diatoms of Northern Illinois, for good slides or material. B. W. Thomas, 132 La Salle street, Chicago, Ill.

SCIENTIFIC NEWS.

— We have received a specimen of the first number of the *Zoologischer Anzeiger*, edited by Prof. J. V. Carus. From twenty-five to twenty-six sheets, of sixteen pages each, will appear each year, a sheet about once a fortnight, we suppose. The literature in all departments except descriptive zoölogy is fully given by title; digests or abstracts of important works are given, C. O. Whitman's embryology of Clepsine being thus noticed. The *Anzeiger* will also contain short notices, zoölogical, zoötomical, faunistic, phænological and biological, with laboratory notes as to improved methods of working, information regarding museums, private collections and personal notices. The plan of this zoölogical index is excellent, and will undoubtedly prove a most convenient medium for advanced zoölogists.

— Arrivals at the Philadelphia Zoölogical Garden: 1 gray squirrel (*Sciurus carolinensis*); 3 beavers (*Castor fiber*), born in the garden; 1 diamond rattlesnake (*Crotalus adamanteus*); 1 ground rattlesnake (*Candisona miliaria*); 1 whip snake (*Bascanion flagelliforme*); 1 black snake (*Bascanion constrictor*); 1 spreading adder (*Heterodon platyrhinos*); 2 brown-throated parrakeets (*Conurus æruginosus*); 1 snake (*Coluber obsoletus, confinis*); 3 bald eagles (*Haliætus leucocephalus*); 1 king snake (*Ophibolus getulus*); 1 woodchuck (*Arctomys monax*); 1 robin (*Turdus migratorius*); 1 snake (*Coluber vulpinus*); 1 rufous rat kangaroo (*Hypsiprymnus rufuscens*), born in the garden; 11 lizards (*Sceloporus undulatus*); 1 red fox (*Vulpes fulvus*).—*Arthur E. Brown, Supt. of Garden, Sept.* 1, 1878.

— The Commissioner of Agriculture has appointed Mr. A. R. Grote, of Buffalo, N. Y., Wm. J. Jones, of Virginia Point, near Galveston, Texas, E. H. Anderson, of Kirkwood, Miss., and Prof. Comstock, of Cornell University, observers, under the control of the entomologist of the Department, to make investigations and study the action of the cotton worm during the present season.

— Prof. Carl Stål, Director of the Department of Entomology of the Royal Museum at Stockholm, died June 13, 1878, aged forty-five years. He was a voluminous author, publishing monographs of different groups of Coleoptera, Hemiptera and Orthoptera.

— Dr. John H. Packard reports in the Medical and Surgical Reporter (Phil., Aug. 3, p. 100) that a child six years of age blew from its nostrils a specimen of Geophilus, a long, slender, small, centipede-like myriopod.

— Herr A. Reipert, of Bensheim, Burgstrasse, Grossl. Hessen, is desirous of corresponding with American entomologists with a view to exchanging European for American insects.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE met at St. Louis, August 21st, the session lasting a week. The president was Prof. O. C. Marsh, Prof. Simon Newcomb being the retiring president. Reports of the eclipse observers seemed to have overshadowed the papers read in the section of geology and biology. The attendance and number of papers read was smaller than the preceding year. An excursion to Colorado took place at the close of the meeting.

THE BRITISH ASSOCIATION met at Dublin, August 14th, under the presidency of Dr. Spottiswoode, the number of members present being 2,577. The addresses of Mr. Evans on Geology, of Prof. Flower on Vertebrate Zoölogy, and of Mr. Romanes on Animal Intelligence were of especial interest, as well as the address of Sir Wyville Thompson on Recent Progress in Ocean Geography.

THE MEETING OF GERMAN NATURALISTS AND PHYSICIANS was held at Cassel, September 11–18, the president being Dr. B. Stilling.

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE was presided over by M. E. Fremy. Prof. Marey delivered a lecture on Graphic Researches relative to Animal Motors, and papers were read by M. Alix on the Myology of Mammals, by Prof. A. Gaudry on the Evolution of Primitive Mammals, and M. A. F. Nogues on Method in Geology and on the Climatology of Geological Times.

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SCIENTIFIC SERIALS.[1]

THE AMERICAN JOURNAL OF SCIENCE.—September. On the animal of *Millepora alcicornis*, by W. N. Rice. Forest geography and archæology, by A. Gray (continued from p. 94). Notice of some recent additions to the marine fauna of the eastern coast of North America, by A. E. Verrill. The Waverly Group in Central Ohio, by L. E. Hicks. On some primordial fossils from South-eastern Newfoundland, by J. F. Whiteaves. New pterodactyle from the Jurassic of the Rocky mountains, by O. C. Marsh.

SIEBOLD AND KÖLLIKER'S ZEITSCHRIFT FÜR WISSENSCHAFTLICHE ZOOLOGIE.—July 30, 1878. On the Siphonophores of deep water, by Th. Studer. Morphology of the Oxytrichinæ, by V. Sterki. Trichaster elegans, by H. Ludwig. Contributions to a knowledge of the Tomopteridæ, by F. Vejdoosky. Contributions to a knowledge of the natural history of the Caprellæ, by A. Gamroth.

QUARTERLY JOURNAL OF CONCHOLOGY.—August. List of shells of Iowa, by F. M. Witter.

[1] The articles mentioned under this head are usually selected.

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ASPIDIUM SPINULOSUM (SWARTZ) AND ITS VARIETIES.

BY GEO. E. DAVENPORT.

DURING several seasons past I have been making some special examinations of the different forms of *Aspidium spinulosum* as found growing in Middlesex county, Mass., and offer the result not as being decisive in character, but for the purpose of calling attention to the points involved, and inviting further investigations in the same direction.

An opinion prevails with many botanists that the large series of forms in this protean species so run into each other, and are oftentimes so confusing and difficult to place, that it would be better to ignore all of the so-called varieties and only recognize all forms under the one specific name. How far this opinion may or may not be correct, and founded on scientific principles, possibly this note may help to determine.

I certainly am not in favor of recognizing as a variety any form not possessing some well marked and permanent character to distinguish it from the recognized typical form of any species. I have so often expressed myself on this point that I do not feel under any apprehension of appearing inconsistent in endeavoring to show that the so-called var. *intermedium* is a good variety at least, if indeed it be not a good species.

The precise distinctions between *Aspidium spinulosum* Swz., and its var. *intermedium* have not as yet been clearly enough pointed out, so that the greatest confusion has prevailed in the effort to verify the presence here of true *spinulosum*, and to discover the differences between it and the variety; the usual assumption having been that nearly if not all of our American plants belonged to the latter form.

My own observations tend to convince me that Swartz's plant is by no means uncommon. Be that as it may, plants are found here abundantly enough that exactly conform to Swartz's description as given by him in his "Synopsis Filicum."

What then is *Aspidium spinulosum* Swz.? Swartz says of it, "Frondibus bipinnatis, pinnis pinnatifidis pinnatisque, laciniis oblongis acutis serrato-spinulosis, fronde ovato-triangularis; rachis glabra, stipite paleaceo." "Addenda et emendata," p. 419 to Synopsis Filicum, 1806. This describes in part nearly all of our American forms. Let us analyze the description and see:

1. *Fronds twice-pinnate.* This is true in many cases of *spinulosum*, and the varieties *dilatatum* and *intermedium*. In large and highly developed specimens of the two last forms the fronds are often thrice-pinnate, and usually appear to be more divided on account of the pinnules being more deeply cut; but the uncertain application of this character to any one particular form renders it unreliable as a specific character, or only of secondary importance.

2. *Pinnules pinnatifid, segments oblong, acute spinulose-toothed.* Common to all of the forms, and therefore as unreliable as the first character.

3. *Frond triangular-ovate.* This more clearly belongs to the var. *dilatatum* than to any other form, although I have had specimens of intermedium that were broadly triangular in outline, and other things corresponding that form might be regarded as Swartz's plant for all there is in the description to the contrary, specimens being found commonly enough that are triangular-ovate in outline, bipinnate in structure, with smooth rachis and pale-brown scales.

4. *Rachis smooth.* This is the case with *spinulosum* and our *dilatatum*, but in *intermedium* the rachis is usually finely glandular. It will be necessary, however, to collect specimens early in order to observe this, as the rachis finally becomes smooth. This makes it difficult, if not impossible, to decide to which form Swartz's description was applied without knowing when, and in what state his plants were collected.

5. *Stipes clothed with pale brown scales.* This is the case, more or less, with all of our forms. The darker scales with blackish centers peculiar to the most highly developed forms are not reliable as a distinctive character.

From this it appears that in point of fact we have no *true spinulosum* as distinguished from other forms unless we choose to make it, and there would be no impropriety in calling it all *spinulosum*, as many are disposed to do, if we did not actually find in nature forms possessing characters sufficiently distinctive to justify recognition.

This being so we can only recognize as typical that form from which, in all probability, the others are most likely to have been derived, and to which, in connection with its special characters, Swartz's description may be best adapted.

Taking, now, the species as a whole, I find that it may be divided into two forms, one being glabrous beneath with perfectly smooth indusia, and the other being more or less finely glandular on the under surface with glandular indusia.

As there are many characters by which we can trace the glandular form to the smooth one, and show clearly enough that if it be not a good species it is at least a variation from that, we may by enlarging the significance of Swartz's "rachis glabra" so as to embrace the smooth indusia, safely assume that the smooth form is Swartz's plant.

But as this distinction is not clearly apparent after the contraction of the indusium in fruit, I have made examinations for the purpose of trying to find some other character by which we could determine specimens with equal certainty at all times; and this I have apparently found in the *position of the sori on the veins.*

Thus I find that in what I here recognize as true *spinulosum* the sori are placed on the *end of the veinlet*, which terminates *within the radius* of the fruit dot, while in the var. *intermedium* the sori are placed on the veinlet *below its apex*, so that it passes through and *beyond the radius* of the fruit dot.

This is a point of distinction between these two forms that has not been noticed heretofore by any one that I am aware of, and although I am not prepared to say that it is invariably the case, it has been so in all of the specimens that I have examined, the only apparent exception having been in the case of two or three imperfectly developed sori.

Let us briefly review and consider the importance of the principal characters of *spinulosum* and the var. *intermedium* as we actually find them in nature.

1. *As to color.* In characteristic specimens the typical form may be readily recognized by the peculiar shade of light-green that distinguishes it from the darker green of the variety. But as we soon find the former growing darker in color and blending with that of *intermedium*, especially as it approaches the so-called var. *dilatatum*, which as we have it in Eastern Massachusetts appears to be only a large, or higher developed state of *spinulosum*, we perceive that the color is not always to be depended upon as a specific character.

2. *As to form.* The terms ovate-lanceolate, oblong-lanceolate and triangular-ovate may be applied to particular fronds of either form, and therefore can only be considered in connection with a series of characters as a whole. In good specimens of what is here recognized as typical *spinulosum*, the fronds will vary from ovate-lanceolate to triangular-ovate. In ordinary forms the two lowest pair of pinnæ are about of an equal length and set obliquely on the rachis; the two or three pairs of pinnæ immediately above are longer, more spreading, though still retaining a somewhat oblique arrangement on the rachis, and give an abruptly dilated appearance to that part of the frond; above, the more or less obliquely-set pinnæ gradually decrease toward the apex, and this comes as near as possible to Swartz's description of "ovato-triangularis."

In characteristic specimens of *intermedium* the frond is usually oblong-lanceolate in outline, with decidedly spreading pinnæ that are not obliquely set on the rachis. But these two forms run together frequently in all sorts of ways, and can only be regarded as of secondary importance.

3. *As to structure.* In ordinary forms of *spinulosum* the fronds are only bipinnate, but this is equally true of the var. *intermedium.*

4. *As to the character of the scales.* This is too unreliable to be considered in any other way than in connection with the whole series of characters. The darker scales with blackish centers are found only on large and vigorous specimens of the var. *intermedium* and, but more rarely in this vicinity, var. *dilatatum*, but both of these forms frequently have pale brown scales like those on *spinulosum.*

5. *As to the character of the indusium.* In *spinulosum* the indu-

sia and under surface of the fronds are perfectly smooth, but in *intermedium* they are more or less glandular.

This character appears to be constant and, therefore, reliable, but it is necessary to collect specimens early in order to observe it, as the glands are fugaceous, quickly disappearing after the indusium begins to contract—a fact which accounts for the difficulty oftentimes experienced in properly placing specimens collected late.

6. *As to the position of the sori on the veins.* If this character proves constant it will be the most important one of all, as it will enable us to place specimens collected at any time with a greater degree of certainty, and, in connection with the character of the indusium, enable us to clear away much of the confusion surrounding the different forms of the species.

I sum up the relative value of the different characters as follows:

1. Color—not constant.
2. Scales—constant in ordinary forms of the species; not constant in the varieties
3. Form—not constant.
4. Structure—not constant.
5. Character of the indusia—constant.
6. Position of the sori on the veins—constant.

It is too much to expect that any species or variety will exactly conform, in every instance, to any prescribed form or character, just as pieces of mechanism cast in dies by the hundred or thousand in unvarying conformity agree with one another; and all we can do is to describe the general characters of a species or variety as we find them in nature.

A species often manifests itself in a great variety of forms, no two plants being exactly alike, and sometimes fronds on the same plant will exhibit surprising variation, so that it is exceedingly difficult to fix the limit and say which of the forms is typical, but as long as these forms can be referred to one common center of variation it does not seem well to recognize any such forms as varieties, and so we endeavor to describe as exactly as possible the character of that center of variation, and judge of all specimens by their relation to that.

When we find plants that cannot be referred to this first center of characters, but evidently proceed from another, if there are no

intermediate forms connecting the second center with the first, then the probabilities are in favor of the second plant being a distinct species; but if the second is directly connected with or related to the first by a graduating series of forms and other characters, then we are justified in regarding the second as a variety of the first, the intermediate forms being rather proofs of the fact than otherwise.

This is exactly the position in which I find *Aspidium spinulosum* and its var. *intermedium.*

As for the so-called var. *dilatatum*, as we have it in Eastern Massachusetts, I have not been able to discover any really good distinctive characters to justify regarding it as anything more than a highly developed state of *spinulosum.* Not only does the form of the fronds often agree with Swartz's description of the species, but frequently, even in very large specimens that appear at first sight more compound, they are only bipinnate in structure. I have so many times traced the ordinary form of the species step by step into our *dilatatum* that I have no faith in it as a variety, but think it should be embraced in the specific description. The smooth under surface and naked indusia clearly place it with the specific form, and in the specimens examined I have found the situation of the sori on the veins exactly the same as in the species.

On the other hand the more northern form, peculiar to the mountainous regions of New Hampshire and Vermont, is so different in appearance, being in every way larger and more compound, that it may be desirable to have some way of designating it, even though the characters are of secondary importance. For this reason it may be as well to retain the variety subject to this limitation.

Var. *Boottii*, I have always been inclined to regard as a distinct species on the supposition of its being a probable hybrid between *A. spinulosum* (*intermedium*) and *A. cristatum*, but if it is to be considered only as a variety, then it comes nearer to *cristatum* than it does to *spinulosum.* So far as my own and the observations of my friends extend, whenever it varies at all it recedes toward *cristatum.* Thus apparently indicating its origin. I have not yet met with a botanist who did not express some such feeling in regard to it.

The upper portion of the fertile frond certainly resembles the

var. *intermedium* in form, in the spinulose character of the pinnæ and the glandular indusia, but on the other hand the lower portion as strongly resembles *A. cristatum*, and it is still more closely connected with the latter species by the character of its sterile fronds. These so often resemble the sterile fronds of *A. cristatum* var. *Clintonianum*, that it is not always possible to separate them if they become mixed. Indeed, the resemblance between the larger forms of *Boottii* and ordinary forms of *Clintonianum* is sometimes so striking that it would be exceedingly difficult to distinguish them if it was not that in *Boottii* the indusiums are always covered with minute glands, while in *Clintonianum* they are perfectly smooth.

For these reasons I cannot subscribe to the opinion that its nearest affinity is with *spinulosum*, but favor removing it altogether from that species, and either placing it with *cristatum* or restoring it to its specific distinction.

But I will not undertake to decide this question here, the only object of the present paper being to give the results of my recent examinations, and to show, first, that we have good typical specimens of *A. spinulosum* in abundance, and second, that the var. *intermedium* possesses sufficiently good distinctive characters to justify our regarding it as a good variety, if not a species.

I submit the following (partial) descriptions of the two forms, intended only to cover the principal points in the present paper:

ASPIDIUM SPINULOSUM Swz. (*A. intermedium* Willd.)

1 to 3 feet high. Stipes clothed with pale or dark brown scales; fronds usually of a light (yellowish) green, sometimes dark, varying from ovate-lanceolate to triangular-ovate, twice or thrice pinnate; pinnæ arranged obliquely on the rachis, the lowest pairs unequally triangular-ovate or sub-deltoid, usually shorter and more oblique than those immediately above, lower pinnules often greatly elongated.

Under surface smooth; indusiums naked; sori terminal on the veins.

ASPIDIUM SPINULOSUM var. *intermedium* Eaton. (*A. spinulosum* Willd.)

1 to 3 feet high. Scales of the stipes pale brown, or brown with darker centers; frond usually dark green, oblong-lanceolate, twice or thrice pinnate; pinnæ spreading, lower often unequally triangular-ovate with elongated lower pinnules.

Under surface finely glandular; indusiums covered with stalked glands; sori medial or sub-terminal on the veins.

Medford, Mass., July, 1878.

NOTE.—In the foregoing paper I have not ventured to disturb the specific arrangement of the plants under consideration, but as the positions therein assumed may, if clearly established, render a re-arrangement necessary, I offer the following sugges-

tion as a basis for a re-arrangement of the different forms of *A. spinulosum* and *cristatum*:

1. ASPIDIUM SPINULOSUM Swz.

   B. var. *dilatatum* Eaton, in Gray's Manual.—Embracing only the extreme northern form.

2. ASPIDIUM AMERICANUM. (*A. spinulosum* Willd., *A. spinulosum*, var. *intermedium* Eaton.)

   1 to 3 feet or more high; scales of the stipe pale or dark brown, often with darker centers, ovate or ovate-acuminate below, paler, narrowly lanceolate, and scattered along the main and secondary rachises above; frond ovate or oblong-lanceolate, twice or thrice pinnate; pinnæ spreading, lanceolate or ovate-lanceolate, acuminate, lower pair sometimes unequally triangular-ovate, with the lower pinnules elongated; pinnules oblong-ovate, acute, lower series longest, more or less incised, or cut clear to the rachis becoming again pinnate; lobes obliquely oblong, spinulosely toothed. Frond dark, often light green, stipe, rachises and veins sometimes purplish, *under surface minutely glandular, sori medial, indusiums glandular.*

3. ASPIDIUM BOOTTII Tuckerman. *Aspidium spinulosum* var. *Boottii* Eaton, in Gray's Manual.

4. ASPIDIUM CRISTATUM Swz.

   B. var. *Clintonianum* Eaton.

   C. var. *Floridanum* Eaton.

I offer the following remarks on the above arrangement:

It is with considerable hesitation that I venture to recommend a new name for a fern so long known as a form of *A. spinulosum* under the name of *intermedium*, as I do not wish to appear to show any disposition to multiply species unnecessarily, or to disturb established and familiar names; but in reëstablishing the present form as a species there appears to be no alternative between doing this and adopting Willdenow's name of *A. intermedium*—a name heretofore improperly applied to our form. But that author's name does not belong here, for his description of *A. intermedium* does not contain a word in regard to the glandular indusiums and under surface, while, on the other hand, his description of *A. spinulosum* does, thus exactly reversing the usual arrangement.

For this reason we cannot write *A. intermedium* Willd., and as Swartz's name of *A. spinulosum* takes precedence and belongs to another form, we are also debarred from writing *A. spinulosum* Willd., thus leaving our plant without a name. Therefore we have no alternative but to provide a new one, and in selecting the present name I have taken into consideration the fact that our American form has always been regarded as peculiar to this continent, a fact which the present name definitely expresses.

The name itself has been used in part only, apparently to describe some form of *A. spinulosum* Sw. (*spinulosum-americanum* Fisch., MS., Index Fil. Moore, p. 104) but whether applied to the present form or to our American plants in general as the name implies, I have no means of knowing. Moore gives as a synonyme var. B. of *Lastrea dilatata*, a fern generally regarded as a distinct species by English authors.

But whatever may have been its application in that form, in bringing it forward here under the present combination, it becomes an entirely new and as much an original name as if it had never been used at all.

I have been led to restore *A. Boottii* to its specific value, and to retain Tuckerman's name for it from the following considerations:

The characters that seem to connect it with *cristatum* are, when more carefully examined, really no stronger than similar resemblances between other and good species.

For example, the sterile fronds of *A. munitum* of the Pacific States, and our northern *A. acrostichoides* are quite as much alike as the sterile fronds of *Boottii* and *cristatum*. Our common *A. marginale* and the Californian *A. argutum* sometimes so closely resemble each other as to suggest a closer relation than is accorded to them. These two species and *A. filix-mas* often appear to run together, having many similar resemblances, yet they are all three undoubtedly good species. Similar and equally strong resemblances may be found existing between many other species, and the puzzling forms of the small Botrychia are sufficient to show how little dependence can be placed, at times, on external appearances alone.

It is sometimes difficult to distinguish small specimens of *Cheilanthes lanuginosa* from *Notholæna Parryi*, and not an uncommon thing for fronds of *Woodsia obtusa* and *Cystopteris fragilis* to become mixed through their close resemblance, and if this occurs among species belonging to entirely different genera, how much more likely is it to occur among closely related species. So that I cannot see why any argument drawn from such resemblances should have more weight in this instance than in those mentioned.

Few ferns are really more distinct than *A. Boottii*. Its individual character is even more pronounced than that of *A. inter-*

medium, and there is seldom any difficulty in distinguishing it at all times from all other ferns by which it may be surrounded. Its wide-spread distribution in this country and Europe (where it was first discovered and described as a species by Braun, under the name of *Aspidium remotum*, and where it seems to preserve its character no less distinctly than with us) entitles it to a higher consideration than that of a mere variety, and although its resemblances to *cristatum* are stronger than its resemblances to *spinulosum*, the glandular indusia keep it always distinct from the former species. In no instance known to me is there any record of glandular indusia occurring in *cristatum* while in *Boottii* they are always present.

Its anomalous character, however, occupying as it does an apparently intermediate position between *spinulosum* and *cristatum*, and the fact that it is generally found growing in company with those two species, has led many to regard it as a probable hybrid, but a proper consideration of this theory will show that while it may be possible for those two species to hybridize as frequently as this theory would pre-suppose, it is hardly probable that they should do so in so many instances, and under such widely different circumstances and surroundings without producing some other than this one particular form, everywhere so uniform in its character. But even this theory, if established, would only result in raising our plant to the dignity of a species, a position to which I think it no less entitled now.

I retain Tuckerman's name, as it is the only one by which our plant is generally known to American botanists, and having been used frequently abroad, it has the additional merit of being the best known and most widely used of all names.

Finally, if it be urged against my paper that, as my investigations have apparently been limited to Middlesex County, they can only be regarded as partial, I answer that those observations were made upon living plants growing in their natural situations, and other examinations of a series of herbarium specimens from Maine, Vermont, Massachusetts, New York and other States, have only strengthened my convictions in regard to them.

During a recent visit to Portland, Me., I visited a number of rich swamps in the neighboring towns and found *A. americanum* to be the prevailing form in that vicinity. I met with *A. spinulosum* but twice, and in both instances the specimens were well marked and characteristic.

Some of the specimens of *A. americanum* were remarkably large and fine, and might have been mistaken for *dilatatum*—with which form large specimens are no doubt often confounded—but a close examination revealed all of the characters that I have described as belonging to this species.

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PLASTER OF PARIS AS AN INJECTING MASS.[1]

BY SIMON H. GAGE, B.S.

THE necessity for some artificial, colored medium to fill the blood vessels must have been felt by the first anatomists. Indeed, injections were rudely made by Eustachius and Varolius in the sixteenth century (Turner, 1, I, 812).[2]

It was left, however, to De Graaf and Swammerdam to fairly initiate the process in the middle of the seventeenth century (Turner, 1, I, 812).

De Graaf used mercury and colored fluids, and was the inventor of the injecting syringe (2, XVII, 291); but it is to Swammerdam that anatomists owe most, for he introduced the use of colored wax (2, XL, 477 and 1, I, 812). This answers fairly the requirements of an injecting mass, as it may be used in the fluid state, but becomes solid very soon afterward. Upon renouncing anatomy for mysticism, Swammerdam gave his secret to Ruysch, his fellow countryman (2, XL, 477), who perfected the art, and fairly approached in skill and excellence of results the refinements of modern anatomy (1, I, 812, and 2, XXXVII, 143).

About the middle of the eighteenth century, Monro *primus* published an essay on anatomical injections (4), in which were given very precise directions for the manipulation and preparation of the injecting mass. It was composed of wax, tallow, oil and turpentine, colored with vermilion, verdigris or lamp-black (3).

In the latest works which treat of the technology of injections (5, 6 and 7), nearly the same formulæ for injecting masses are given; and except a mere mention of gypsum in Martin (7, II, 99), all coarse masses are solid at ordinary temperatures and must

[1] This paper is based upon investigations made in course of the preparation of a Manual for the Dissection of Cats, by Prof. Burt G. Wilder and the writer.

[2] See list of works referred to at the end of this paper. The first figure designates the number on the list; the last, the page; the middle, Roman numeral, the volume.

be heated before use. The subject must also be thoroughly warmed.[1]

Plaster of Paris has long been used as an injecting mass, in the medical schools of this country at least. It seems to be admirably adapted to this purpose from its well known property of becoming solid when mixed with water.

Although plaster has not the defects of the masses that require warming before use, there are difficulties in its manipulation. I have been unable to find anything upon the matter in books; and gentlemen connected with medical schools say they do not know of any printed directions; but this process of injecting, like other expedients is handed down by tradition from one demonstrator to another. All that I have been able to learn from others of the technology of plaster injections is that the plaster should be mixed to a thin paste with water (with a saturated aqueous solution of arseniate of soda at one medical school) and used, uncolored or colored with vermilion or red lead, very quickly before it has time to set.

The lack of precise information as to its manipulation, and the skill and certainty necessary to use simple plaster and water, from its rapid setting, render it hardly manageable by students. Yet it is so simple and excellent for coarse injections that some careful experiments were made, in the anatomical laboratory of the Cornell University during the last college year, to render it practicable, if possible, for the use of students by elucidating the following particulars:

1. The character of the plaster to be used.
2. The proportions of plaster and fluid.
3. The best and cheapest red and blue colors.
4. The means by which the plaster may be kept fluid ten to thirty minutes after mixing without preventing it from hardening finally.
5. The precautions necessary in making permanent the preparations injected with the plaster mass.

(1.) It was found that the very finest plaster is best, and indeed necessary if it is desired to fill the smaller vessels.

(2.) Equal volumes of plaster and fluid give the best results. This forms a very fluid mass which penetrates finely and sets firmly.

[1] According to Martin and Frey (7, II, 101 and 10,174), fine cold flowing injecting masses may be made by dissolving copal and mastic resin, with a small proportion of wax, in sulphuric ether, and coloring with red lead; or by dissolving the finest red sealing-wax in absolute alcohol. These masses harden as soon as the ether or alcohol soaks into the tissues.

A thicker mass is much more difficult to manage. A slightly greater proportion of fluid may be used if the finest vessels are to be filled. The fluid includes all the liquid used in mixing the mass; viz, coloring liquids, restrainers and water.

(3.) As to the red and blue colors, there are several that answer admirably. For red, vermilion or red lead ground in a mortar with a little water to get rid of lumps may be added in sufficient quantity to give a bright color. A saturated aqueous solution of magenta or red aniline is the easiest to use of all the red colors. It does not diffuse and color the tissues as one might expect, but colors the walls of the vessels a very bright red. An ammoniacal solution of carmine is, however, the best red. A sufficient quantity of this is added to the mass, and then the carmine is precipitated with fifty per cent. acetic acid. The acid should be poured into the colored mass, with constant stirring, till the color changes to the bright red of dry carmine, and there is a distinct odor of the acid. It is necessary to precipitate the carmine, as an alkaline solution diffuses through the walls of the vessels and stains the surrounding tissue. The advantage in precipitating the carmine in the mass is its uniform diffusion. The same method is employed in coloring red the finest gelatin masses for histological injections (9, 10 and 11).

A saturated solution of Berlin blue is the best blue, but as this is difficult to prepare (8, 403, 9, 164 and 10, 180), the ordinary Berlin or Prussian blue of the shops will answer if it is ground with water to a homogeneous paste. The simplest blue is, however, a saturated aqueous solution of blue aniline.

The aniline colors are the easiest to use, as it is simply necessary to add to the mass a sufficient quantity of the solution to produce the desired tint.[1]

(4.). It has been known a long time that if alum or borax is burned with gypsum, the resulting plaster will not set for three or four hours after mixing, but will finally set nearly as hard as marble (12). It is said by Tomlinson (13, I, 829) that ordinary plaster may be kept fluid four or five hours after mixing with water by adding a little *size* or beer; and it is a matter of common experience that the greater the proportion of water the longer it takes the plaster to set. It is necessary to give the mass a cer-

[1] Leamon's red and blue aniline dyes answer very well, and may be bought at any drug store.

tain consistency in order to have the resulting injection successful, therefore the amount of water could not be increased sufficiently to retard the setting over four or five minutes. As to the alum-plaster, it is difficult to obtain, and has the same objection as the mass to which *size* has been added; viz, it is too long in setting, for it is often desirable to begin a dissection in comparative anatomy almost immediately after the injection has been made.

It was noticed that a mass colored with carmine solution and afterwards acidulated with acetic acid remained fluid a much longer time than when colored with a red or blue with which no acid was used. Experiment showed that plaster mixed with an equal volume of ten per cent. acetic acid remained fluid ten to twenty minutes. The time was increased when carmine solution was used with the acid, as in practical injections, but not when any other colors were added. It was also found that if the plaster was mixed with either of the following solutions, instead of water, the setting was retarded ten to thirty minutes: A ten to twenty per cent. aqueous solution of alcohol or glycerine, or a ten per cent. solution of arseniate of soda. Either of these restrainers may be used with either of the colors. The arseniate and the acetic acid make the plaster friable, but the others do not.

It is important to state that a mass which has been treated with a restrainer may be kept perfectly fluid much longer by agitation. This is also true of plaster and water, but not in so great a degree.

In all of the experiments the plaster, after being thoroughly mixed with the fluid, was poured into small paper boxes like those used in imbedding for microscopical sections. It was found in practice that the plaster hardened much quicker in the blood vessels than in the paper boxes. This is probably because the restrainers and all superfluous liquid soak into the tissues, leaving only the amount of water necessary to crystallize the plaster.

(5.) If one desires to make a *permanent* alcoholic or dried preparation of any part or organ injected with plaster, the aniline colors must not be used, as they are not enduring. The alcohol should be seventy-five per cent. or stronger, and slightly acidulated with acetic acid (alcohol 200 parts, acid 1 part) to preserve the brightness of the Berlin blue and the carmine red (10, 202).

The part to be preserved should not be placed in alcohol till the plaster has become thoroughly hardened. An hour will usually suffice.

Practical Application of the Plaster Mass.—It will be readily seen that the plaster mass is far superior to a wax mass for ordinary work. It is simply necessary to mix it well with an equal volume of fluid; and the subject needs only to be bled. Wax involves great expense and trouble in preparation, and both it and the subject must be thoroughly warmed before the injection can be made (7, II, 100 and 3). The warming is objectionable especially with cold blooded animals.[1]

Plaster is also very neat, it never softens, but makes the injected vessels like cylinders of stone. It penetrates very finely, filling arteries half a millimeter in diameter, and has a great range of uses. It is well adapted to fill various ducts, like the thoracic, pancreatic, etc. The valves in the veins, the semilunar valves of the aorta and pulmonary artery may be most satisfactorily demonstrated with it, and with a little care and experience the action of the auriculo-ventricular valves of the heart may be nicely shown.

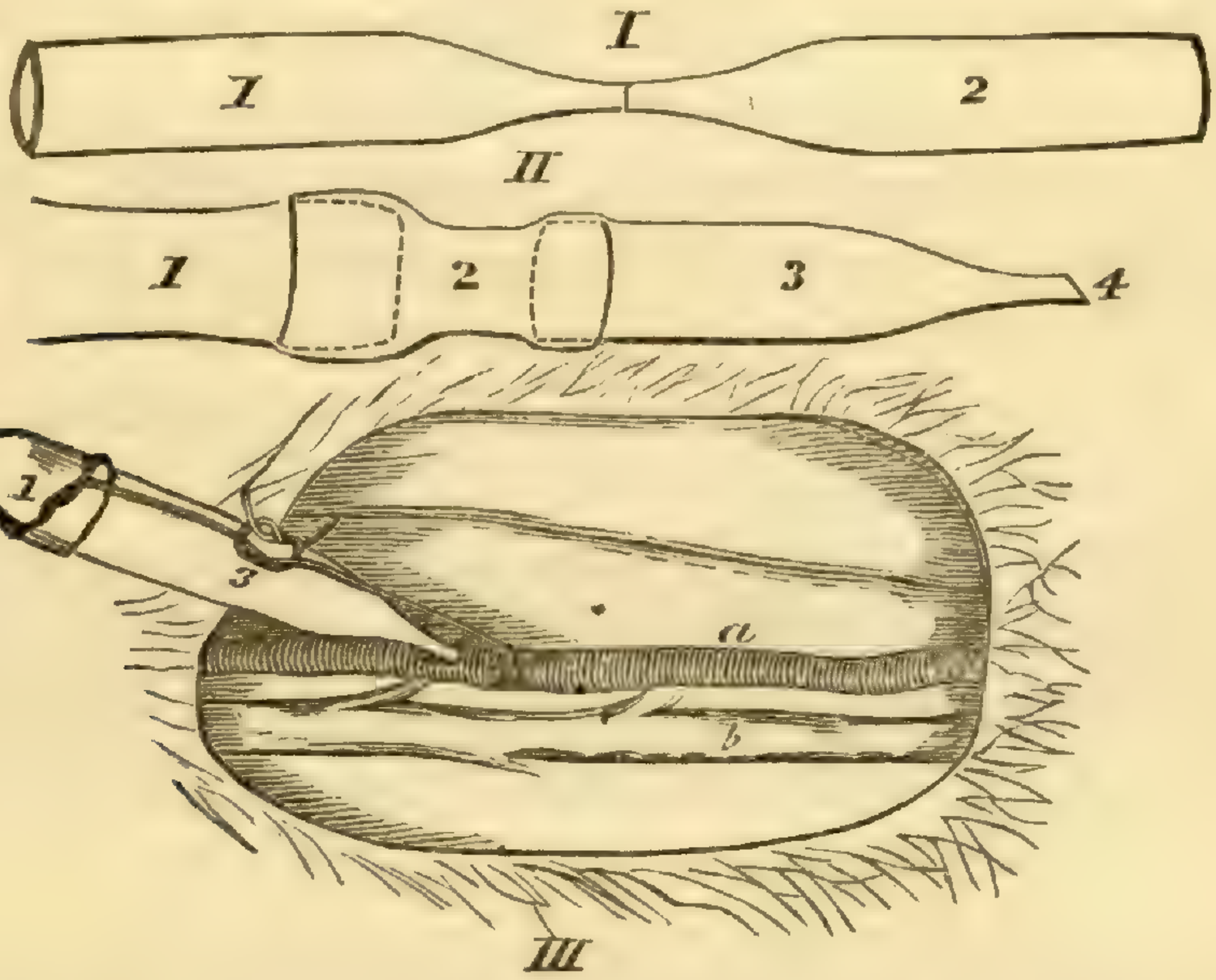
Vessels or ducts injected with plaster may be dissected out neatly, and placed on cardboard to dry. The appearance of the dried preparation is nearly like that of the fresh specimen, as the plaster prevents shrinkage. Preparations so made will last indefinitely if they are well poisoned with arseniate of soda before drying. Specimens injected with plaster colored with Berlin blue and carmine, have kept three months in slightly acid alcohol without the least change.

The accompanying diagrams are introduced to show the cheapness and simplicity of an injecting apparatus, and its practical application in plaster injecting.

An 8-ounce lead or britannia syringe, with a leather packed piston, works very well indeed and costs less than one dollar. The canula is so large, Fig. II, 1, that it cannot be put into the vessels. Fine canulæ for this purpose may be made by any per-

[1] It is objectionable to warm thoroughly a mammalian animal after death, as it greatly hastens decomposition. It is particularly objectionable to warm cold-blooded animals, for the warm water, into which they must be put, acts as a powerful stimulus, causing general tetanus, unless one waits half a day or a day after apparent death. The tissues, especially of *amphibians*, are greatly softened by the warm water, in fact partially cooked. It is also a great deal of trouble to warm the animal and the mass in summer.

son out of a small glass tube, as shown in Fig. I. The fine canula is connected with the canula of the syringe by means of a tightly-fitting rubber tube, Fig. II, 2.



EXPLANATION OF THE DIAGRAMS.

FIG. I.—1-2, a glass tube 6 mm. in diameter is evenly heated in the center over an alcohol or Bunsen flame, and drawn out till it is only 1–2 mm. in diameter. A scratch is then made with a fine file and the two are broken apart.

FIG. II.—1, the large canula of the syringe; 2, rubber tube serving to connect this large canula to the fine canula, 3; 4, the oblique end of the fine canula, made by carefully grinding with a fine wet file. The sharp edges at both ends of the glass canula may be removed by cautiously heating in the flame.

FIG. III.—The artery and vein of the left leg are exposed, and the artery is represented as ready for injection. To inject the body it is simply necessary to change the direction of the canula. *a*, femoral artery; *b*, femoral vein; 1, surgeon's knot on the large end of the canula; 2, insertion of the canula into the artery; 3, knot connecting the strings round the artery and the large end of the canula.

All the knots shown in the figure should be hard knots like 3.

In order to inject, the given vessel or duct is exposed and a longitudinal slit made in it. The fine canula connected to the rubber tube, Fig. III, is put into the vessel, and a string tied in a hard knot around the vessel so that it will press on the canula. One end of this string is then tied to another string coming from the large end of the canula, Fig. III, 1. This prevents the canula from slipping out of the vessel.

After the canula has been tied into the vessel, the injecting mass is prepared. Let it be for the arterial system of a cat. 100 cc. of the finest plaster of Paris is put into a clean dish, and 84 cc. of a ten per cent. aqueous solution of alcohol, glycerine

or arseniate of soda is added, and the whole well mixed. Then 8 cc. of carmine solution is stirred into the mass, and finally 8 cc. of fifty per cent. acetic acid is poured in with constant stirring. The fine canula and rubber tube are filled with water to avoid getting air into the vessels. The syringe is then filled with the prepared plaster mass and the large canula of the syringe is connected to the fine canula by means of the rubber tube. The pressure should be *steady* and *continuous*. There is very little danger of bursting arteries if the pressure is steady.

Before the injection is commenced, a string should be put around the artery beyond the end of the canula and loosely knotted with a surgeon's knot. (In a surgeon's knot the string is put through the loop twice as shown in Fig. III, 1.) As soon as no more mass can be forced into the vessels the surgeon's knot should be tightened, and the fine canula and syringe thoroughly washed with water. All the dishes used in making the injection should be washed immediately before the plaster hardens. The most scrupulous cleanliness is necessary to prevent lumps of hardened plaster from clogging the syringe or the vessel which is being injected.

In case veins are to be injected they should be, as far as possible, emptied of blood, and the injection must be made from some peripheral vessel like the femoral or jugular veins, on account of the valves. It is well if the injection is made into the femoral vein, for example, to have the jugular open to allow the blood to flow out as the plaster is forced in. There is no danger of the plaster running out, for it cannot pass the valves.

As a rule a dissection may be begun in half an hour after the injection.

FORMULÆ FOR PLASTER MASSES.

The amounts given are those necessary for an ordinary cat, and cost two to five cents:

1. Finest plaster of Paris.....100 cc.
   Red lead or vermilion..... .... 50 grams.
   Either of the following restrainers.....100 cc.
   Ten to twenty per cent. aqueous solution of alcohol or glycerine, or a ten per cent. solution of arseniate of soda.
2. Plaster. .....100 cc.
   Restrainer..... 84 cc.
   Ammoniacal solution of carmine..... 8 cc.
   (Dry carmine 1 gram, ammonia 2 cc. Grind the two in a mortar and add 22 cc. of twenty per cent. glycerine,)
   Fifty per cent. acetic acid..... 8 cc.

3. Plaster..... 100 cc.
   Saturated aqueous solution of magenta or aniline red..... 25 cc.
   Restrainer..... 75 cc.

4. Plaster..... 100 cc.
   Berlin blue in powder.....2 grams.
   Restrainer..... 100 cc.

5. Plaster..... 100 cc.
   Saturated aqueous solution of aniline blue..... 10 cc.
   Restrainer..... 90 cc.

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ON THE NATURAL SUCCESSION OF THE DICOTYLEDONS.[1]

BY LESTER F. WARD, A.M.

THE system of classification for dicotyledonous plants now in use in most text books of botany is substantially that of Antoine Laurent de Jussieu, as published in his *Genera Plantarum* in 1789. Although many minor modifications have been made and are still being made by different authors, the fundamental arrangement into three "Divisions," depending on the nature of the corolla, has been maintained in its integrity to the present

[1] A sequel to the article on the *Genealogy of Plants* in the June number. The substance of the two articles was embodied in a paper read before the Philosophical Society of Washington, February 16, 1878.

day; only two serious attempts having yet been made to cut loose from it, one of which has failed to command an acceptance, notwithstanding the eminence of its author, while the other is still too new to permit an opinion as to its ultimate success. I refer to Dr. Lindley's classification as elaborated in his *Vegetable Kingdom*, and to the system proposed by Sachs in his *Text Book of Botany*.

In the first,[1] or, as it is supposed, highest of the three "Divisions," the corolla consists of distinct pieces or *petals* not at all connected with each other, and this is called the Polypetalous division. In the second group these petals are united, at least at their base, the distinct divisions only appearing, if at all, in the form of a "limb" of separate lobes at the summit of a tube of greater or less length. This group is called the Monopetalous division. The third group wants the petals and corolla entirely, the perianth consisting of a single envelope which is always assumed to be the outer or calyx Plants of this nature form the Apetalous division; they are also frequently denominated monochlamydous, those of the other two divisions being designated as dichlamydous.

The defects of this classification have long been apparent, and although so persistently adhered to, it has always been a source of trouble to systematists, no two ever entirely agreeing as to its precise limits. Even those who wholly ignore or reject the doctrine of descent seek to bring together as nearly as possible those plants which actually resemble each other most, since this is the fundamental idea, and formerly the only idea, of a "natural system." Yet in adhering to the principle involved in the classification by divisions this was frequently impossible, the two principles being often in direct conflict. In every such case it is clear that the maintenance of the divisions involved, is so far, an *artificial*, as contradistinguished from a *natural* system of classification. And indeed it is difficult to see how a system of classification based on the corolla is more natural or less artificial than one based on the stamens. If it could be shown that this class of characters are

[1] The propriety of commencing text books of Botany or Natural History with the highest or most perfectly organized families and descending the scale so as to end with the lowest or most imperfectly organized may well be questioned. Though doubtless more convenient for beginners to study, it tends to antagonize and keep out of view the truth of a progressive historical development in living things which, to the majority of students, is of greater value than any technical acquaintance with specialized forms.

more permanent or reliable, or that they are more comprehensive, and better typify the general sum of the characters distinguishing groups of plants, a point in their favor would be gained, but, as we shall see, such is not the case. In point of fact these characters frequently change when nothing else has changed, and often remain the same when everything else widely differs. They constantly tend to "run together," and no strict dividing line exists between them. They also frequently vary within very narrow groups, sometimes in the same species or individual. Critically viewed, therefore, this system so far as it goes, presents as many imperfections and stands as directly in the way of the adoption of a truly natural system as did the professedly artificial one of Linnæus.

The recognition of the three Divisions, as is made in nearly all systematic works on botany, even the most recent, involves numerous direct conflicts with the best established orders of dicotyledonous plants. Many orders are found to contain species and genera whose corollas would require them to be placed in a different Division from that in which the order itself has been placed. Examples of this class are abundant. *Paronychia*, a genus which seems clearly to belong to the polypetalous order *Caryophyllaceæ* (*Illecebreæ*), is usually apetalous, though some species retain a rudiment[1] of the petals in the form of minute teeth or bristles; *Chrysosplenium* in the order *Saxafragaceæ* is another example of the same class. *Glaux* in the monopetalous order *Primulaceæ* is destitute of a corolla. *Ludwigia*, *Ammannia*, *Penthorum*, *Nyssa*, are further illustrations, and only the most familiar need be mentioned. Most of the *Euphorbiaceæ* in this country (if we except *Euphorbia* itself), which are monœcious, have polypetalous staminate (male), and apetalous fertile (female) flowers. Here we have the two extreme divisions united in the same individual plant (*Croton*, *Tragia*, etc.).

[1] The term "vestige" would probably be more correct. It is certainly remarkable that this term has not been more generally adopted to express this important distinction so clearly perceived by the naturalists of this epoch. The terms "rudiment" and "rudimentary" should be confined to those organs which the life-history of the plant or animal shows to be in process of development or formation. On the other hand those organs which, from disuse or other causes, have dwindled into mere remnants of once perfect ones should be distinguished by the term "vestiges" or an equally appropriate and expressive one. Yet these are the so-called "rudimentary organs" which have played so great a *rôle* in the modern theories of science, and Mr. Darwin himself employs this expression in that sense without commenting on its bad etymology.

Again, there are cases in which the lobes of the nominally gamopetalous corolla are so deeply parted that it becomes difficult to determine whether they are at all united, and in which the union sometimes actually ceases to exist. Of this class might be mentioned at random *Symplocos*, *Statice*, *Naumbergia*, *Anagallis*, *Chionanthus*, *Fraxinus*. The last named genus is of special interest in consequence of the close general resemblance between the ash and maple families, which are, however, widely separated in the present system. That beautiful climber, *Boussingaultia baselloides*, commonly known as the Madeira vine, is botanically related to the *Portulacaceæ*, but the petals are barely united at the base, for which reason it has been removed from its natural association and placed in the monopetalous division.

Thus we find that while some botanists have preferred to maintain well established orders intact by allowing them to embrace genera and species whose corolla would require them to be placed in different divisions, others have chosen rather to remove such anomalous genera to their appropriate divisions and if necessary to create new orders for them. Some, for example, leave *Paronychia*, *Anychia*, etc., in the *Caryophyllaceæ*, with which they are clearly allied, while others place them in the apetalous division near the *Polygonaceæ* with which they doubtless are also allied. But there are many cases which cannot be thus easily disposed of, as the *Aquifoliaceæ*, *Euphorbiaceæ*, *Asclepiadaceæ*, etc., in which cases the entire order is changed about from one division to another, according as the author may think the preponderance of characters requires.

Not only does it frequently occur that an order which cannot be divided contains genera representing two of the general types of corolla upon which the divisions are founded, but some orders, as the *Primulaceæ*, actually embrace all three of these types. In the order just named we find *Naumbergia* which is frequently polypetalous, and *Glaux* which is always apetalous, while most of the genera are monopetalous.

These few examples, which might easily be extended, certainly show that the so-called divisions of the *Dicotylæ* do not form a natural series. They rather indicate that they represent three parallel and co-ordinate series, in any one of which orders closely corresponding may be named in one or both the others. Thus the *Caryophyllaceæ* may be compared with the *Polygonaceæ*, the *Acer-*

ineæ with the *Oleaceæ*, the *Aquifoliaceæ* with the *Rhamnaceæ*, the *Malvaceæ* with the *Euphorbiaceæ*, and the *Hamamelaceæ* with the *Platanaceæ*. These comparisons and others that will suggest themselves to every botanist, reveal natural relationships between plants which are far removed from each other because they fail to agree in the one character on which the divisions are based. They clearly show, therefore, that the arrangement by divisions is an artificial one, and that the fact of the coherence or non-coherence of the petals is far from a reliable one as indicating the true succession, much less the genealogical descent of the families.

It is not claimed, however, that the three mostly parallel series wholly fail to express any general law of the vegetable kingdom, and an attempt will be made before concluding the subject to show that they do express in a partial manner an important truth in phytonomy. Though concurrent for a great part of their length and inosculating all along, these lines of development appear not to have had a simultaneous origin. But before entering upon the direct treatment of this problem it will be necessary to consider another class of facts.

The practice thus far dwelt upon of distorting the natural system by an undue regard for the corolla is only one example under a general class. The vice itself expressed in general terms, is that of adhering too closely to any one character to the neglect of all the rest. We thus find cases within the same division in which orders unquestionably allied are not placed together, but are widely separated. Every one has been struck by the resemblance of certain Ranunculaceous with certain Rosaceous plants, especially as to foliage and general habit; for example, *Ranunculus* with *Geum*, *Actæa* with *Spiræa*, etc. It is customary with botanists to affect a certain degree of contempt for such general resemblances, and they are commonly regarded as wholly misleading. That they cannot be depended upon as safe guides to special investigation all will of course admit, since it so frequently happens that striking similarities exist between families which cannot in any way be assimilated. But even in such cases the resemblances often vanish on closer inspection and prove to have been produced by entirely dissimilar processes. General resemblances which will bear close inspection are rarely without a meaning. There is a certain correlation which subsists

among all the characters of a plant so that those which have similar organs of reproduction usually exhibit strong family relationships. Were it not so familiar it would be a surprising fact that a Solanaceous plant can usually be detected as such without examining the flowers, merely by a certain undefinable appearance which belongs to the family. The same is true to a greater or less extent with all the large orders, *Cruciferæ*, *Borraginaceæ*, *Urticaceæ*, etc. In some families still more subtle characteristics persist with great uniformity, of which the peculiar odor of the *Orchidaceæ* is a good example.

This so-called "general aspect" is in reality the *ensemble* of all the characters which make a plant such as it is, and though any one character is as liable to vary as another or as more obvious ones, their number is so great that it requires an enormous period of time to so efface them all as to destroy all traces of resemblance. Not so of any particular character which botanists may fix upon. This may vary in a manner comparatively rapid, and thus it doubtless often happens that species really related and bearing a general resemblance are divorced in the text books on special differences.

This co-existence of so large a number of minor peculiarities as to give to two plants or groups of plants an obvious general resemblance should therefore be welcomed as a valuable accessory to the work of classification, not as a special guide to truth but as a general check upon error. A strong *physiognomic* resemblance between two groups of plants should at least raise a suspicion of their genetic relationship, and might frequently furnish a theory for the investigation of important questions. In a previous paper it was shown how the physiognomy of the *Cycadaceæ* pointed to their natural position between the ferns and the palms, and how a closer inspection of the more reliable characters sustained this conclusion. If now we return to the case of the *Ranunculaceæ* and *Rosaceæ* above referred to, we shall find a further confirmation of this law. A careful comparison of all the genera of these two orders, which has been recently made, reveals the fact that there is to be traced "an easy transition from the wholly conical and much elongated receptacle of *Ranunculus* and *Myosurus* to that of *Fragaria*, flattened at the base and conical in the center, or of *Rubus* with its raised margin and convex center. From this we may pass to *Sibbaldia*, *Potentilla*, *Horkelia* and

Stylobasium."[1] On the same principle the *Portulacaceæ* have been very closely assimilated to the *Cactaceæ*, with which they are found to agree in an astonishingly large number of characters, including that of the irritability of the stamens. Again the *Droseraceæ* and *Saxifrageæ* are now known to be closely allied families, as their physiognomy would indicate. And strange as it may at first appear, there is little doubt that the *Cruciferæ* are related to the *Onagraceæ* by natural affinities more or less close. Further investigations from the same point of view will doubtless enable us to go much farther in discovering the true affinities of dicotyledonous plants.

It is undoubtedly the special function of the floral envelopes, as it is of the ovary, to protect the germ, and the degree of this protection is the most reliable index we have to the degree of advancement in vegetal life. The means employed in securing this end in the *Dicotylæ* are two-fold: first, the relation in which the calyx stands to the ovary; and second, the character of the inner envelope or corolla. Botanists, while they have not ignored either of these essential characteristics, have generally placed more weight upon the second than upon the first, although for the purpose named the first has doubtless been of equal service to plants.

From the hypogynous to the perigynous, and from this to the epigynous calyx-tube, there is certainly a steady progress in the direction of protection, and the advance of the calyx towards the more complete enveloping of the ovary may be regarded as indicating an equivalent advance in organization. In Dr. Lindley's great work on *The Vegetable Kingdom*, this was made the leading character, although in his earlier works he had followed the system of Laurent Jussieu; and Prof. Julius Sachs in his *Text Book of Botany*, though in most respects making an entirely new departure in botanical classification, places the *Rosaceæ*, *Onagraceæ*, *Myrtaceæ*, and other strictly epigynous families at the head of the system as representing the highest type of development.

The classification by divisions, on the other hand, professes to give special prominence to the corolla as an index of progress, but how obscure the notion of any direct advantage to be derived from it to the plant must have been with the founders of that sys-

[1] Baillon, Histoire des Plantes.

tem, is shown by the order in which the divisions were arranged. It seemed evident to their minds that those plants which were wholly destitute of a corolla, the apetalous or monochlamydous division, should stand at the base, and thus far they were certainly consistent. But in placing the polypetalous division at the head of the system, the idea of its protecting function must have been quite forgotten. For unquestionably the monopetalous corolla is the form of floral envelope which affords the greatest protection to the ovary and stamens, and the more nearly this approaches to the tubular form the more complete is that protection. The distinct, usually spreading, and often fugacious petals of polypetalous plants are of very little service in this respect, so that, in so far at least as this one principle is concerned, they should certainly stand next above the *Apetalæ*.

In this respect too, it is true, certain monocotyledonous plants would take a higher rank than some apetalous and polypetalous *Dicotylæ*, their tubular perianths forming better protecting envelopes. But as it is the genealogical series that the new taxonomy seeks, other more fundamental characteristics must preclude all attempts to derive the *Monocotylæ* from any advanced stage of the *Dicotylæ*.

The general truth, which is becoming more and more apparent, is that the floral envelopes cannot alone be relied upon to indicate the course of development of the Dicotyledons, and that for the natural arrangement of the families many other considerations must be taken into the account. Instead of depending upon any one character it is necessary to consider all the characters together. The task, it is true, is vastly more difficult, and systematic botany becomes a science requiring exhaustive study, but the conclusions reached will be correspondingly more valuable.

One of the best checks by which the genealogical systematist may frequently orient himself, is what has been called the "physiognomy" of plants. Whenever the pursuit of any particular character or set of characters is found to have brought into close proximity plants of a totally different physiognomy, it is generally safe to conclude that the process has been carried too far; and on the other hand, when, as is frequently the case in the present system, plants having strong general resemblances have been widely separated, the propriety of reviewing the evidence

on which such separation was based is at least strongly suggested. The resemblance, above pointed out, which the *Caryophyllaceæ* bear to the *Polygonaceæ* illustrates this. In these orders the corolla and the ovary, two of the most reliable characters, are sufficiently distinct in typical genera to justify a separation, but when led by the stipules, swollen joints, leaves, habit, and other peculiarities that combine to make up their general appearance, to place them in juxtaposition and study them comparatively, we find that even these characters fail in certain genera, while the relationship indicated by the physiognomy is partially supported by more respectable evidence. We have already seen that several members of the chickweed family are apetalous. On the other hand some genera of the *Polygonaceæ* may be regarded as at least functionally dichlamydous, as in *Chorizanthe*, the one-flowered involucre closely imitating a calyx. And further, the capsule of several genera of the *Caryophyllaceæ* (*Paronychia*, *Anychia*, *Scleranthus*) is reduced to a one-seeded utricle approaching the achenium of the buckwheat family.

While, therefore, the time has not yet arrived for the attempt to be made to trace out the line of genealogical descent of the Dicotyledons, it is evident that a complete re-adjustment of the orders, to a great extent independently of the present divisions, will have to be made and might soon be undertaken.

The first dicotyledonous plants were in all probability apetalous, and all authors agree in placing the *Amentaceæ* (*Juliflores* of Sachs) at the bottom of the scale. It is certainly not without significance that the *Casuarineæ*, whose possible descent from the *Gnetaceæ* (*Ephedra*) was referred to in the previous article, belong to this group.

The origination and development of the corolla was doubtless by a process similar to that by which the calyx was formed. In both cases it was the advantage, however slight, which the plant derived from it that occasioned its progressive development into a protecting organ. In the *Amentaceæ*, as also in many *Monocotylæ* (*Cyperaceæ*, *Graminæ*), these envelopes are very imperfect, often reduced to mere scales. Polypetalous plants (and doubtless apetalous also) may be of two kinds, according as the petals may be shown to represent rudiments of a gamopetalous corolla in process of development, or only *vestiges* of one which they formerly possessed. The terms "polypetalous" and "monopet-

alous" do not properly designate the process by which these organs are developed. According to the accepted principles of phyllotaxy, each petal (as also each sepal) represents a transformed leaf; but the embryological study of those plants in which the corolla takes the form of a tube, has proved that this has not been produced by the union of the original petals, but by the formation at first of a ring at their base which acquires greater prominence until it eventually assumes the character of a tube. To better indicate this process the terms "eleutheropetalous" and "dialypetalous" are employed by certain authors to denote that the petals are distinct, the term "gamopetalous" being used for the very objectional one "monopetalous."

If natural selection has had anything to do with the development of these organs, it is certain that the free petals must have historically preceded the tube, and hence we may conclude that for the earliest forms of each division the order of succession was: first, *Apetalæ*; second, *Eleutheropetalæ*, and third, *Gamopetalæ*, and therefore to whatever extent these divisions may now be parallel and coördinate, they were not so at the outset.

If, therefore, we were to accord to the general principle of protection, as above pointed out, its full force in the classification of dicotyledonous plants, at the same time keeping in view certain subordinate laws by which it is qualified, we should probably find, in attempting to reconstruct the present system, that while the so-called divisions would be virtually abolished and the orders within each very much blended and intermixed with those of the others, there would still remain an ascending series based on the perfection of the floral envelopes, and in which as now those plants classed as apetalous would in the main stand at the base. The intermediate terms of this series would, however, unlike the present system, consist chiefly of those orders now placed in the polypetalous division, while the highest of these terms would be represented by the monopetalous orders with tubular corollas. This arrangement would be further modified by the relation of the calyx to the ovary and minor considerations. In fact, if the true genealogy of the *Dicotylæ* is ever worked out it will doubtless be found to conform to the general law in all departments of life, and to assume the arborescent form, whose ultimate ramifications it would be wholly impossible to trace in the present state of the science.

Very little more than this can at present be predicted with regard to what the true "Natural System" really is, which we are still so far from understanding; but it would seem from the peculiar character of *Compositæ*, and especially from the double safeguard of their narrowly tubular corollas, their epigynous calyx (*pappus*), and syngenesious anthers, still further secured by the massing of the flowers into dense heads, that this order, which is also the largest in the vegetable kingdom, should be regarded as the highest and most specialized family of plants, and might be fitly made to crown the natural system.

The general arrangement above outlined is further substantiated by the limited data which palæontology affords. The greater part of the fossil plants of this class have been found in the Cretaceous formation. They nearly all belong to the apetalous and polypetalous Divisions, but by far the greater number to the former; such genera as *Salix*, *Quercus*, *Platanus*, *Sassafras*, etc., occur most frequently, and some of these have been traced to the lowest Cretaceous strata if not to the Jura. That they existed in still earlier times can scarcely be doubted, and high authorities have fixed upon the Trias as the probable epoch in which the earliest dicotyledonous genera made their appearance. In the Upper Cretaceous certain polypetalous genera begin to be found, among which are numbered *Magnolia*, *Liriodendron*, *Prunus* and other multi-staminate plants, most of which have been assigned a high rank in the current system. This fact and others seem rather to indicate that a great many stamens and an elongated receptacle are marks of a low organization, as if just emerging from the catkin-stage. Very few gamopetalous plants are found fossil, strongly implying that they belong to late Tertiary periods. Especially significant is the absence of those having elongated tubular corollas, while it is believed that the first fossil *Composite* plant is yet to be discovered.

Little, therefore, as is really known of the natural succession and actual genealogy of the Dicotyledons, we may, nevertheless, fairly claim to have acquired sufficient data to warrant entering upon the investigation of this difficult and complicated problem, a task which must owe a great share of its success to the aid to be rendered by a rational hypothesis.

A STUDY OF THE POPULAR NAMES OF THE MENHADEN.

BY PROFESSOR G. BROWN GOODE.

THE menhaden, *Brevoortia tyrannus* (Latrobe) Goode, has at least thirty distinct popular names, most of them limited in application within narrow geographical boundaries. To this circumstance may be attributed the prevailing ignorance regarding its habits and migrations, which has perhaps prevented the more extensive utilization of this fish, particularly in the Southern States. It accounts for the extraordinary blunder of the compilers of the fishery statistics of the census of the United States for 1870, in which the oils produced from the white-fish of the great lakes (*Coregonus albus*) and the white-fish of Connecticut are classed as identical, a blunder which is followed by a number of others of the same character and quite as certain to mislead. The discrepancy of local names also enables us to understand how the extensive manufacturing interests and fisheries connected with this fish have gradually sprung up, little noticed save by those directly interested in the business.

In Maine and Massachusetts the name "pogy" is almost universally in use, though in the vicinity of Cape Ann it is partially replaced by "hard-head" and "hard-head shad." The name "menhaden" is exclusively applied in Southern Massachusetts, the Vineyard sound, Buzzard's bay and Narragansett bay where it appears to have originated. From the eastern boundary of Connecticut to the mouth of the Connecticut river the name "bony-fish" predominates, while in the western part of the State the species is usually known as the "white-fish." In the waters of New York the usage of two centuries is in favor of "mossbunker," a name which also holds throughout New Jersey. In Delaware bay, the Potomac, and Chesapeake bay other variations are found in "alewife" and "greentail." Virginia gives us "bug-fish" in its various forms, while in North Carolina we first meet the name of "fat-back," which is more or less prevalent as far south as the St. John's river, Florida. In all the Southern States, especially in the vicinity of Beaufort, N. C., the names "yellow-tail" and "yellow-tailed shad" are occasionally heard. I am informed that in the Indian river, Florida, the fish is occasionally called the "shiner" and the "herring."

Among the manufacturers in Port Monmouth, N. J., who prepare the menhaden as an article of food, a number of trade names are in use, such as "American sardine" (in distinction from the European fish which is prepared in a similar manner), "American club-fish," "shadine," and "ocean trout."

These names are not separated in their distribution by sharply defined boundaries. Still, as a glance at the table will show, the *habitat*, if that term may be legitimately used, of each local appellation appears to be clearly marked. Where there is a discrepancy it can usually be explained. For instance, the general use of the name "menhaden" in the vicinity of Boothbay, Me., is due to the presence of a large number of fishermen and laborers from Rhode Island who carry on the oil-factories in that region. In the same way the name "bony-fish" has been naturalized at Montauk point and Napeague, N. Y. The factories in that neighborhood are owned by firms in Eastern Connecticut, and the Connecticut "bony-fish fleet" has a favorite cruising ground in the waters of Eastern Long Island. The names "menhaden," "bony-fish" and "moss-bunker" have been introduced into Florida by northern fishermen, who prosecute the winter shad fisheries on the St. John's, and these same names are more or less familiar all along the coast wherever the northern coasters and fishing vessels are known.

The adoption of some one suitable name for popular use is eminently desirable. "Menhaden" is the name most generally known, as well as the most distinctive. It has the additional recommendation of having been derived from an aboriginal language. It has been used in the titles of the two manufacturers' associations, and it is hoped that this usage will soon be conformed to by all.

A few words concerning the origin of the above-mentioned names may not be out of place. "Pogy" and "menhaden" are derived somewhat remotely from the Indian dialects of New England, the latter apparently from that in use in Massachusetts and Rhode Island, the former from a more northern source.

For the explanation of the derivation of these names I am indebted to Prof. J. Hammond Trumbull, who writes, "*Munnawhatteaûg* corrupted to *Menhaden*, means, literally, 'fertilizer' ('that which *manures*'). This name was applied to the herring and alewife as well as the 'menhaden' proper—all these species being used by the Indians for manuring their cornfields.

"In the northern and eastern parts of New England the *Brevoortia* is commonly called *Paúhagen*, and probably in some localities 'poghaden' (as you write it and which is nearer the Indian original), though I have not heard it so pronounced by eastern fishermen. This name in the eastern dialects has precisely the same meaning as 'menhaden' (or rather *munnawhatteaûg* in Southern New England). The Abnaki (*i. e.*, coast of Maine) name was *Pookagan* as Rasles wrote it, and the verb from which it is derived he translated by 'on engraisse la terre.'"

According to Mr. J. V. C. Smith, the older fishermen of Northern Massachusetts, New Hampshire and Maine called the fish by the Indian name "pauhagen," and I myself have heard it called "poghaden" by old fishermen about Cape Cod. The modern name may easily have been derived from this by dropping the final syllable. At the present day this name is almost universally in use among the fishermen north of Cape Cod, though it is occasionally varied by "poggie" and "porgy." The use of the latter name should be carefully avoided: the same name, a corruption of the Indian "scuppaug," being commonly applied to another fish, the "scuppaug" or "scup" (*Stenotomus argyrops*).[1] As may be supposed, the name of Narragansett origin is most exclusively used in Southern Massachusetts and on the shores of Narragansett bay, the former home of that tribe of Indians. In its present form it first appeared in print in 1792, in the New York Agricultural Transactions, in an article by the Hon. Ezra L'Hommedieu.

"Hard-head" and "bony-fish" explain themselves, both referring to the same peculiarity of structure. The former name was first used about 1813 by Belknap in his History of New Hampshire; the latter, as well as "white-fish," by President Dwight in his Travels in New England.

The application of "white-fish" is also sufficiently evident, although this name is not a distinctive one, being applied to a large group of North American fresh-water fishes, the *Coregonidæ*, and in certain localities to the blue-fish (*Pomatomous saltatrix*). In England the term "white fish" is used to designate cod, had-

[1] This probably misled De Kay, who stated that the menhaden were known at the eastern end of Long Island as "skippaugs." He also remarked that "pauhagen" (pronounced *Pauhaugen*) was the Narragansett epithet, while "*menhaden*" was that applied by the Manhattan Indians.

dock, hake, ling, pollock, soles, turbot, plaice, halibut, and whiting.

"Mossbunker" is a relic of the days of the Dutch colony at New Amsterdam, and the name is still lovingly retained by the inhabitants of Manhattan island. It was in use as early as 1661, as we learn from an allusion in Jacob Steendam's poem in "Praise of New Netherland" (*'t Louf van Niew Nederland*).[1]

Allusion has already been made in the letter of Prof. Trumbull, to the great schools of "marsbanckers" seen by Dankers and Sluyter on their visit to New York, in 1679, and every one remembers the reference to this fish in Irving's "Knickerbocker," in connection with the death of the renowned trumpeter, Antony Van Corlear, where the name first appears crystallized in its present form.[2]

The derivation of this name may be easily traced, it having evidently been transferred by the Dutch colonists from the scad or horse-mackerel, *Caranx trachurus* (Linn.) Lacepede, a fish which annually visits the shores of Northern Europe in immense

[1] This poem, cited by Prof. Trumbull in the Report of the Commission of Fish and Fisheries for 1871–'72, p. 168, was printed, with an English translation, by Hon. Henry C. Murphy, for the Bradford Club of New York (Anthology of New Netherland: Bradford Club Series, No. 4, 1865, pp. 52, 45).

The allusion to the Mossbunker is as follows:

"Swart-vis, en Roch, en Haring, en Makreel
Schelvis, Masbank, en Voren die (se veel)
Tot walgins toe, de netten'vuld; en heel
Min ward ge-eeten."

"The black and rock fish, herring, mackerel,
The haddock, mossbanker, and roach, which fill
The nets to loathing; and so many, all
Cannot be eaten."

[2] "It was a dark and stormy night when the good Antony arrived at the creek (sagely denominated Haerlem *river*) which separates the island of Mannahatta from the main land. The wind was high, the elements in an uproar, and no Charon could be found to ferry the adventurous sounder of brass across the water. For a short time he vapored like an impatient ghost upon the brink and then, bethinking himself of the urgency of his errand, took a hearty embrace of his stone bottle, swore most valorously that he would swim across in spite of the devil (Spyt den Duyvel), and daringly plunged into the chasm. * * * An old Dutch burgher, famed for his veracity, and who had been a witness of the fact, related to them * * * that he saw the duyvel, in the shape of a huge moss-bonker, seize the sturdy Antony by the leg and drag him beneath the waves. * * * Nobody ever attempts to swim across the creek after dark, and as to the moss-bonkers, they are held in such abhorrence that no good Dutchman will admit them to his table who loves good fish and hates the devil."

A History of New York * * * By Diedrich Knickerbocker. New York, 1809.

schools, swimming at the surface in much the same manner as our *Brevoortia*, and which is known to the Hollanders as the *Marsbanker*.[1]

In the Museum Ichthyologicum of Gronow, published in 1754, the name *Marsbanker* is used in speaking of a scombroid fish, frequently taken with the herring, probably the same referred to above.[2]

The name is variously spelled "moss-bunker," "moss-bonker," "mass-banker," "mouse-bunker," "marsh-bunker," "marsh-banker," and "morse-bonker," and is also familiarly shortened into "bunker," a name in common use at the eastern end of Long Island.

The name "alewife" was given by the Virginia colonists to this species from its resemblance to the allied species known by that name in England. This name is preoccupied by the *Pomolobus pseudoharengus*, and should never be applied to *Brevoortia*.

The presence of a parasitic crustacean (*Cymothoa prægustator*) in the mouth of *Brevoortia*, when found in southern waters, explains the name "bug-fish" prevalent in Delaware and Chesapeake bays, the Potomac and Rappahannock rivers, and the inlets of North Carolina, with its local variations of "bug-head." and "buggy-head."[3] "Yellow-tail," "yellow-tailed shad," and "green-tail" refer to the yellowish-green tint of the caudal fin, observed only in Southern specimens. The former of these names has led to some confusion among our correspondents, the same name being applied in Georgia and Florida to a very different fish, *Bairdiella punctata* (Linn.) Gill.

An allusion to the oily nature of the flesh is found in "fat-back," a name in general use in the Southern States. This name is sometimes applied in Northampton county, Virginia, to the mullet (*Mugil lineatus*). In the last century it was used for the *Albula vulpes*.

[1] See Schlegel, Die Dieren van Nederland, Visschen, p. 4.

[2] 80. *Scomber* linea laterali aculeata, pinna ani ossiculorum triginta, *Arted. gen.* 25, n. 3, *Synon.* p. 50, n. 3.

Scomber linea laterali curva, tuberculis osseis loricata, *Gronov. act. ups.* 1742, p. 83, ibique defer. Trachurus, *Bossuet*, ep gr. p. 74, *Bellon. Aquat.* p. 180, *Dale.* Hist. of Harw., p. 131, n. 5.

Belgis *Marsbanker* Frequentissime in Mari Septentrionale cum Clupeis p. 5, n. 4, descriptis capitur.

op. cit. p. 34.

[3] Captain Atwood states in the Proceedings of the Boston Society of Natural History, x, 1865, p. 67, that the half-grown menhaden are called "bug-fish" by the Virginia negroes, because they believe them to have been produced from insects, since they never find spawn in them there.

ABOUT WEEDS.

BY W. W. BAILEY.

WHAT is a weed? Generally speaking it is any plant that interferes with the operations of agriculture or gardening. Some plants are weeds because by their rapid growth they thrive to the exclusion of better things; others are so, simply from their unsightly appearance and their uselessness. There is never a question in one's mind as to whether a pig-weed (*Chenopodium*) is a weed or not. Its rank and homely growth, its inconspicuous flowers and its very limited uses, at once discard it from the catalogue of desirable plants. So is it with the burdock (*Lappa officinalis*), although this possesses elements of beauty to redeem it. Its large, crumpled leaves spring up in odd corners of yards, about houses, or on dust-heaps where little else would grow, and serve to cover disagreeable objects. The flowers, too, are very pretty, as all young people know who have woven them into parti-colored mats and carpets.

Perhaps weeds meet with less charity than any of God's creations. They are active enemies, not to be despised so much as hated. They are cut down or uprooted wherever found, or, if by chance overlooked, take possession of our entire grounds. So great a pest are they that man has taken them for the type of a rank and rapid growth. Yet, when curiosity leads us to observe them, there is much beauty in these simple plants which we ruthlessly tread beneath our feet. We might learn a useful lesson from the persistency with which they surmount all obstacles and survive every misfortune. The delicacy of taste, also, which leads a few to seek the richest soils or the sunniest exposure is worthy of our praise. And then, how social are they in their habits, forever seeking the improving society of their betters! They take such enjoyment in life, too, frolicking over the meadows, coquetting with their reflections in the brook, or climbing "where the air is delicate" upon the the eaves of our houses, where they remind us of Alice Pynchon's posies.

Many of them, were they only less common, would be highly prized. Indeed, it is at times difficult to draw the line between true flowers and weeds. Think what the dandelion would be were we not accustomed to its golden buttons and feathery globes! Look, too, at the luxuriant growth of the cotton-thistle

(*Onopordon*)! How prodigal is it of its material, as it throws out its silvery leaves and royal tufts of crimson. Those old Caledonian kings were fellows of good taste when they chose this noble plant as the floral symbol of a nation. Armed at every point it stands, like some sturdy Highlander, to repel aggressors.

The corn-cockle (*Lychnis githago*) and the cone-flower (*Rudbeckia hirta*) are both beautiful, as well as the flea-banes (*Erigeron*), daisies (*Leucanthemum*) and St. John's worts (*Hypericum*). Their only fault, and that is sufficient to condemn them, is that they will grow where nobody wants them. Our waste places would be deserts, indeed, did not nature kindly interpose to clothe them with these humble plants. Many species are unmistakably homely, yet even in the least showy there is much of beauty when the microscope is summoned to our aid. Flowers which seem too insignificant to be considered for a moment, will be seen when thus magnified to equal any of their prouder kindred, and to be as strangely and as wisely fashioned.

A weed which is troublesome in one place where the conditions are proper for its rapid extension, need not be so in another where those conditions are not fulfilled. Consequently we find that very different things are called weeds in the different portions of the Union, while some, like the shepherd's purse (*Capsella bursa-pastoris*) or the purslane (*Portulaca oleracea*), are of universal distribution. A plant may have flourished and multiplied in one locality, when if removed to another it will become restricted, and while useless, will no longer be regarded as a weed. The ox-eye daisy (*Leucanthemum vulgare*) comes to us from Europe, and although very beautiful to look at, is a great nuisance to the farmer: hay-fields in June are often made white with the showy heads of this troublesome plant. On the other hand, some of our weeds, like *Anacharis*, have invaded Europe, and some English weeds are rapidly supplanting the native flora of Australia and New Zealand.

Weeds are variously interesting according as they are viewed. If we keep a garden we will find the purslane an undeniable nuisance, and a vigorous enemy. If, on the other hand, we are indifferent to its invasions, and approach it as a friend, we will find it, together with most other weeds, possessed of beauties of which we had no conception.

We have already spoken of the beauty of the daisy, the bur-

dock, and some of the larger weeds. Let us now look at the smaller flowers, like those of the dead-nettle (*Lamium amplexicaule*), and any others of the mint family (*Labiatæ*). Some of the small *Cruciferæ* are also pretty, although they are weedy enough in appearance. The hedge-mustard (*Sisymbrium*) is the most pronounced weed that we know.

The little Veronica which we often find on grass-plats, has a most bewitching flower, which from its minuteness most persons would fail to observe. The corolla is white, and veined with the most delicate pencilings of violet, all pointing towards the center of the flower, so that we here gain beauty and information simultaneously. Its beauty is evident to any observer, but what does it teach? We have said that the colored veinlets all pointed to the center, and this, we believe, is true of all flowers where such markings occur, as shown a long time ago by Sprengel, who claimed that they serve as guides to the insect seeking nectar. Recent observations have proved his theory to be probably correct.

There is no more desirable ground for the beginner, than the waste places and open lots about our cities. Here he will find any number of plants with which it is well to become familiar. They can do no harm where they are, except by circulating their seed, and they are so little regarded by disdainful man that he can claim the whole collection as his own, and receive the municipal thanks for appropriating them. Side by side with the native and European weeds, we will sometimes find the prince's feather (*Polygonum orientale*), the Canary grass (*Phalaris canariensis*) and various other exotics. As the summer advances there will be a perfect tangle of weeds in such a place, evening primroses, *Datura stromonium*, *Lychnis*, melilots white and yellow, Canterbury-bells, amaranths, &c., some showy, others merely coarse and offensive. By the side of the streets we may find the homely cockle-bur (*Xanthium*) or the pretty moth mullen (*Verbascum blattaria*), with a white or yellow corolla, and stamens clothed with violet hairs. The common mullen (*Verbascum thapsus*) we will be sure to find, and if in New England, will meet the autumnal dandelion (*Leontodon autumnale*) which here blooms all summer. It is quite unlike the ordinary dandelion, and has branching green stems, smaller heads, and a tawny pappus. The *Polygonaceæ* present the common smart-weed, the knot-weed,

man's ever-present comrade, and the narrow-dock. More attractive plants are the wood-sorrel (*Oxalis stricta*), with its yellow bells closing as the sun declines, and with its light and graceful leaves, so pleasantly acerb; several species of clover (*Trifolium*) and *lucern* (*Medicago*); the Deptford-pink (*Dianthus armenia*), with its only star, and the celandine (*Chelidonium*).

To those who cannot take long walks, and who yet are interested in nature, we commend these weed gardens which are free to all. They will find a great number of families represented; a great many plans of growth illustrated; many beautiful blossoms, quaint seed-vessels, graceful grasses, and delicious odors, to reward them.

We do not pen these lines in order to save any weed of them all from destruction. The tares must be rooted out or what will become of the wheat? In fact, we are fully conscious that the very next time we see an impudent pig-weed overtopping our favorite marigolds, we will pluck it up root and branch. We merely desire to show that even the poor man may have his botanic garden; that in the words of Lowell:

> **"A weed is nought but a flower in disguise,**
> **Which is seen through at once if love give a man eyes."**

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RECENT LITERATURE.

WALLACE'S TROPICAL NATURE.[1]—The gifted author's long residence in the tropical regions of the old and new world, and his large way of looking at nature, induced by extensive travel and acute observation in both hemispheres, have enabled him to produce a book, which, for the breadth of its views, and interest of its style, must claim a place among those few works in existence of which Humboldt's Views of Nature is a type. Wallace's general views, however, of tropical life and nature while fresh, and based on manifold and novel facts, will not perhaps be considered as particularly original to those who have read Humboldt's narratives and essays. Our author accounts for the great richness and variety of the plants and animals of the tropics by the uniformity of the equatorial climate in all parts of the globe. "Over a large portion of the tropics," he writes, "the same general features prevail, only modified by varying local conditions, whether we are at Singapore or Batavia, in the Moluccas, or New Guinea,

[1] *Tropical Nature and other Essays.* By ALFRED R. WALLACE. London, MacMillan & Co., 1878. 8vo. pp. 356.

at Para, at the sources of the Rio Negro or on the Upper Amazon, the equatorial climate is essentially the same, and we have no reason to believe that it materially differs in Guinea or the Congo." On the other hand the glacial period disturbed the uniformity of the temperate zone and caused a partial extinction of life. Where there are departures from the typical equatorial climate, as in rainless and desert tracts, this seems probably due to the nature of the soil or the artificial clearing away of the forests, and he cites the case of Central India where "the scanty and intermittent rainfall, with its fearful accompaniment of famine, is no doubt in great part due to the absence of a sufficient proportion of forest-covering to the earth's surface." He then calls attention to the fact that "with but few and unimportant exceptions a great forest band from a thousand to fifteen hundred miles in width girdles the earth at the equator, clothing hill, plain, and mountain with an evergreen mantle. Lofty peaks and precipitous ridges are sometimes bare, but often the woody covering continues to a height of eight or ten thousand feet, as in some of the volcanic mountains of Java, and on portions of the Eastern Andes." This forest belt merges into woody and then open country, soon changing into arid plains or even into deserts, where the great equatorial currents of air laden with moisture do not penetrate.

The primeval forests of the equatorial zone are distinguished from the forests of the temperate zones by their vastness, "and by the display of a force of development and vigor of growth rarely or never witnessed in temperate climates." There is also a great variety of specific forms, while the individuals are less numerous, this being the reverse of what is to be seen in the Temperate and Arctic Zones.

Animal life is likewise more abundant and varied specifically, many groups, as butterflies, parrots, humming birds, apes and monkeys, lizards, frogs and snakes being pre-eminently tropical, and in the tropics, "evolution has had a fair chance" while in the Temperate Zone, with its glacial periods, "it has had countless difficulties thrown in its way. The equatorial regions are then, as regards their past and present life history, a more ancient world than that represented by the Temperate Zones, a world in which the laws which have governed the progressive development of life have operated with comparatively little check for countless ages, and have resulted in those infinitely varied and beautiful forms—those wonderful eccentricities of structure, of function, and of instinct—that rich variety of color, and that nicely balanced harmony of relations, which delight and astonish us in the animal productions of all tropical countries."

While the chapters on tropical life occupy the first half of the book, the second half is devoted to essays on the color of animals and plants, and the origin of color-sense; on some relations

of living things to their environment; on the rise and progress of modern views as to the antiquity and origin of man, and on the distribution of animals as indicating geographical changes. These essays, though on recondite subjects, are of great general interest, and presented in the attractive style characteristic of the author's other popular works and essays.

BIBLIOGRAPHY OF NORTH AMERICAN INVERTEBRATE PALÆONTOLOGY.[1]—Works such as these, though laborious and requiring much time in their preparation, are naturally useful in proportion as they are full and accurate. The present work is probably as complete as others of the sort, the names of the compilers giving assurance that it is. In its scope the bibliography is confined to those works which treat, either wholly or in part, of invertebrate fossils found within the limits of North America, including the West Indies and Greenland, and, for convenience, the comparatively few contributions of American authors to the palæontology of other countries, and published in their own, have been included in Part I. Among the omissions that occur to us are papers and notes by Verrill and Scudder, Wood, and Packard on the Quarternary fossils of New England and Labrador, contributed to the Memoirs and Proceedings of the Boston Society of Natural History, and the Portland Society of Natural History, also Ordway's article on Paradoxides in the Proceedings of the Boston Society of Natural History.

PROCEEDINGS OF THE CENTRAL OHIO SCIENTIFIC ASSOCIATION.[2]—The members of this Association, which seems to have been quietly working for three years past, have done themselves no little credit by the publication of the first part of their Proceedings. The papers are mainly on archæological and historical subjects; among those on the former topics are two by Mr. T. F. Moses on the ancient remains of Mad River valley, with an account of the opening of the Baldwin and Roberts Mounds, and on the shell heaps of the coast of Maine. Mr. J. E. Warren contributes a report of a survey of earthworks on Haddix hill, Ohio, near Osborn, Ohio, and an account of a sculptured rock from Marblehead, Ohio. Rev. Geo. Gibson reports on the ancient pottery found near Green Bay, Wisconsin. The Society cannot do better than to continue to explore, and carefully map out all Indian mounds in the State, and figure the remains found in them. Such contributions are of lasting value.

[1] *Bibliography of North American Invertebrate Palæontology*, being a Report upon the Publications that have hitherto been made upon the Invertebrate Palæontology of North America, including the West Indies and Greenland. By C. A. WHITE, M.D., palæontologist of the U. S. Geological Survey, and H. ALLEYNE NICHOLSON, M.D., D. Sc., etc., Department of the Interior. U. S. Geological Survey of the Territories, F. V. HAYDEN, U. S. Geologist. Miscellaneous Publications, No. 10. Washington, 1878, 8vo, pp. 132.

[2] *Proceedings of the Central Ohio Scientific Association.* Urbana, Ohio, Vol. i, Part 1. Published by the Association, Urbana, 1878. 8vo, pp. 96, 16 plates.

WILSON'S PYCNOGONIDA OF NEW ENGLAND.[1]—This interesting group has at length received attention so far as the New England species are concerned, and is treated in such a manner that all the forms can be readily identified. Views of certain authors are adopted, for which no good morphological reasons are given, that these Arachnida have antennæ, the cheliceræ or mandibles being regarded as such. Both from embryological and morphological data, the arachnida in all their subdivisions seem to us to want these appendages, present in Myriopods and Hexapods. The systematic and artistic work seems to have been thoroughly well done. Appended is a table intended to show the general geographical and bathymetrical distribution of the species described in the present paper.

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Forsatte Bidrag til en rigtig Opfattelse af Örèstillingen hos Flyndrene [Flounders]. Af Japetus Steenstrup. 8vo, pp. 74, 4 plates. Kjöbenhavn, 1878. From the author.

On the Erupted Rocks of Colorado. By F. M. Endlich. (Extracted from the Tenth Annual Report of the U. S. Geolog. Survey for the year 1876). 8vo, pp. 199–272. Washington, Gov't Printing Office, 1878. From the author.

On the Structure and Origin of Mountains, with special reference to the "Contractional Theory." By Jos. LeConte. (Read before the National Acad. of Sciences, April 19, 1878.) 8vo, pp. 95–112. From the author.

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Description of a new Fish from the Lower Chalk of Dover. By E. S. Newton, Esq., F.C.S. (Extracted from the Quar. Jour. Geolog. Society, August, 1878.) 8vo, pp. 439–446, 1 plate. From the author.

Til Kundskab om to arktiske Slægter af Dybhavs-Tudsefiske; *Himantolophus* og *Ceratias*. Af Dr. Chr. Lütken. 4to, pp. 309–348, 2 lithog. plates. (Extracted from Vidensk. Selsk. Skr., 5te Række, Naturvidensk. og Mathematisk Afd. 11te Bd. v.) Kjöbenhavn, 1878. From the author.

Palæontological Report of the Princeton Scientific Expedition of 1877. By Henry F. Osborn, Wm. B. Scott and Francis Spier, Jr. September 1, 1878. (Contribution No. 1 from the Museum of Geology and Archæology of Princeton College.) 8vo, pp. 146, x plates. New York, 1878. From the director of the Museum.

Preliminary Studies on the North American Pyramidæ I. By A. R. Grote. (Ext. from the Bulletin of the U. S. Geolog. Survey. Vol. iv, No. 3.) 8vo, pp. 669–705. Washington, July 29, 1878. From the author.

The Palæontologist, No. 2, September 14, 1878. 8vo, pp. 9–16. Cincinnati, U. P. James From the editor.

Proceedings of the American Association for the Advancement of Science. Twenty-sixth meeting, Nashville, Tenn., August, 1877. 8vo, pp. 400. Salem, Mass., 1878.

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[1] *A Synopsis of the Pycnogonida of New England.* By EDMUND B. WILSON. From the Transactions of the Connecticut Academy of Arts and Sciences, Vol. v, August, 1878. 8vo, pp. 26, 7 plates.

Upon the Relative Agency of Glaciers and Sub-glacial Streams in the Erosion of Valleys. By W. H. Niles. Boston, 1878. (From the Proceedings of the Boston Society of Natural History, Vol. xix.) 8vo, pp. 6.

Upon the Occurrence of Zones of Different Physical Features upon the Slopes of Mountains. By W. H. Niles. Boston, 1878. (From the Proceedings of the Boston Society of Natural History, Vol. xix.) 8vo, pp. 7.

Ueber Dimorphismus und Variation einiger Schmetterlinge Nord-Amerikas. Von J. Boll, in Dallas, Texas, 1876. Separatabdruck aus Verhandlungen des Vereins für Naturwissenschaftliche Unterhaltung in Hamburg (1876). Bd. iii. Hamburg, Marz-April, 1878. 8vo, pp. 10. From the author.

On the Nauplius Stage of Prawns. By C. Spence Bate. (From the Annals and Magazine of Natural History for July, 1878.) 8vo, pp. 7.

On the Mollusca procured during the "Lightning" and Porcupine Expeditions, 1868–70 (Part i). By J. Gwyn Jeffreys. (From the Proceedings of the Zoölogical Society of London, April 16, 1878.) 8vo, pp. 23, 2 plates.

Isthmia nervosa, a study of its Modes of Growth and Reproduction. By J. D. Cox. Illustrated. (Reprinted from the American Jour of Microscopy.) 8vo, pp. 10.

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Recensio systematica animalium Bryozoorum, quæ in itineribus, annis 1875 et 1876, ad insulas Novaja Semlja et ad ostium fluminis Jenisei, duce Professore A. E. Nordenskiöld, invenerunt Doctores A. Stuxberg et H. Théel, Auctore F. A. Smitt. (Öfversigt af Kongl. Vetenskap Akademiens Förhandlingar 1878, No. 3, Stockholm.) 8vo, pp. 16.

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GENERAL NOTES.

BOTANY.

NEW CLASSIFICATION OF THE VEGETABLE KINGDOM.—At the close of his recent work, La Morfolojia Vegetale, Professor Caruel of Pisa proposes the classification of the vegetable kingdom into five primary groups as under, viz.:

1. *Phanerogamia.*—Every individual is trimorphic. The first form is neutral, and is capable of indefinite development, and of organic reproduction, principally by means of buds. The organic form gives rise, through the medium of the flower, to the two other sexual forms, male and female, which have only a definite development. The male form or pollen is thalloid; the female form or gemmule (ovule) is cormoid; this last produces first, a pro-embryo as the result of the fecundation, by the fovilla of the pollen, of an oösphere contained in a closed oögonium, and finally the embryo of the neutral form which develops at the extremity of the pro-embryo, and in the same direction. In the subdivision of Phanerogamia, Professor Caruel discards the distinction between Gymnospermia and Angiospermia, retaining as the two primary classes Monocotyledons and Dicotyledons, and giving the higher rank to the former.

2. *Schistogamia*, including *Characeæ* only. These are also trimorphic; but the male sexual form consists of verniform phy-

tozoa (antherozoids) instead of pollen-grains, formed in an antherocyst (antheridium), differing in structure from the anther; the female form consists of an oögemma (archegonium) comparable to a gemmule, but naked; the neutral form springs directly from the oösphere, which, on germinating, produces the embryo transversely.

3. *Prothallogamia* or Vascular Cryptogams.—These are also trimorphic. The neutral form does not produce the two sexual forms, but spores, these, on germinating, are transformed into sexual prothallia, with archegonic and naked oöspheres, and vermiform phytozoa contained in antheridia; the oöspore gives rise transversely to the embryo of the neutral form. The Prothallogamia are divided into *Heterosporæ* and *Isosporæ*.

4. *Bryogamia* (synonymous with *Muscineæ*).—The distinguishing character of this group is the indefinite power of development of the (female) sexual individual, together with the definite development of the neutral form or sporogonium. A consequence of this is the repeated and continued fecundation of which the female form is capable, which distinguishes the Bryogamia from the three preceding groups. The embryo springs directly from the oöspore; the male forms are phytozoa. The group is divided into *Musci* and *Hepaticæ*.

5. *Gymnogamia* (Thallophyta or Cellular Cryptogams).—The simplest Gymnogamia possesses only a single form which is reproduced organically by fission, by conidia and sporidia, or by gamogenesis, but without any sexual differentiation. In others there is sexual differentiation into male and female forms; a few have also a third neutral form, when the oöspore produces zoöspores, instead of passing directly into the female form. They resemble the *Bryogama* in the definite development of the neutral form, and the indefinite development of the female form, but differ in the zoöspore-like form of the phytozoa, and in the structure of the oögonium, which is isolated and naked, and does not form parts of an archegonium. Professor Caruel altogether discards the old classification of Thallophytes into Algæ, Fungi, and Lichens, but does not propose any other in its place, and thinks it probable, that as our knowledge of some of its forms increases, it will be broken up into several primary groups. He considers it would be an advantage if the term Cryptogamia were altogether disused.—*Alfred W. Bennett.*

Rare Ferns in Central Florida.—On December 26, 1877, I met with *Blechnum serrulatum* Michx. in profusion at the northwest end of Santa Fe Lake, Florida. Subsequently I found it, equally abundant, on the opposite shore of the same lake. In both cases it grew in low hummock land, in the latter instance surrounded with magnificent specimens of the *Magnolia grandiflora* (trunks two feet in diameter), while in its neighborhood grew rather sparingly the rare and graceful *Polypodium plumula* H. B. K.

hitherto found, I believe, only at Tampa Bay. This additional station for the latter fern, so far in the interior, is of interest in its distribution. The former fern is recorded in Chapman's Flora as being found in Florida, on authority of Michaux and Buckley; while in William Edwards' Catalogue of North American Ferns, 1876, corrected by Professor D. C. Eaton, the habitat of "near Enterprise, Florida" (on the St. John's River) is given, so that I presume it is considered uncommon, if not rare.

I may also mention that I met with *Ophioglossum nudicaule* L. f. in an old field about one mile to the westward of Santa Fe Lake. I observed a habit in this diminutive fern (it is often barely one inch in height) which may not be generally known. I noticed that the spike or fertile part comes up wrapped in the winged petiole of the sterile part of the frond, and so remains, completely enclosed, till well advanced in its development.—*Henry Gillman, Waldo, Florida.*

Lycopodium cernuum in Florida.—In November, 1877, I found this rather elegant species growing in abundance on the sides of a damp, deep ditch, at Santa Fe Lake, Florida. It seemed quite at home, developing many protean forms and luxuriant vegetation. But it grew only where the clay had been exposed or thrown out in constructing the ditch, which is many years old. Dr. Chapman in his "Flora of the Southern United States," does not include *L. cernuum* L.; but I believe it is common in the tropics. I am not aware that it has hitherto been discovered within the United States. At any rate, it is interesting to find it so well established on these high lands in Central Florida. I also find frequent, in the low pine barrens in this same neighborhood, *L. inundatum* L. var. *pinnatum* Chapm., hitherto recorded as from "near the coast, West Florida."—*Henry Gillman, Waldo, Florida.*

Botanical News.—The *Bulletin* of the Torrey Botanical Club for July and August contains some rambling notes on collecting and preserving herbarium specimens which will be of value to young botanists. Professor Eaton records the discovery of a rare and curious moss, *Conomitium julianum*, at Hamden, Connecticut. A farther note on the bibliography of North American lichenography by Mr. H. Willey, and a critical, lengthy notice of Rafinesque's monograph of Lechea, together with a notice by O. R. Willis of the occurrence of *Calluna vulgaris* at Egg Harbor, New Jersey, with references to other new New Jersey plants, complete the number.

The seventy-sixth fasciculus of the Flora Brasiliensis consists of the *Lemnaceæ* by Hegelmaier, and the *Araceæ* by Engler. The morphology and anatomy of the duck weeds, by the former author, is illustrated by a fine plate. The flowers and fruit of *Lemna* (Spirodela) *polyrhiza* are drawn from North American

specimens, as all those seen from Brazil are, like the British ones, barren. Messrs. Godwin and Salvin's forthcoming Biologia Centrali-Americana will contain a full catalogue of the known species of plants of Central America by Mr. Hemsley.

Pringsheim's Jahrbuch für Wissenschaftliche Botanik for 1878, contains a paper by Woronin on Plasmodiophora, the cause of "anbury" in turnips. R. Sadebeck writes on the development of the embryo of the horsetails (Equisetum) and H. Banke on the germination of the *Schizæaceæ*.

In the *Botanische Zeitung*, H. Nebelung continues his spectroscopic researches on the coloring matters of some fresh water *Algæ;* A. DeBary discourses on a apogamous ferns, and the phenomena of apogamy, in general.

The French Academy has elected as corresponding members of the section of Botany, Dr. Asa Gray and Mr. Charles Darwin.

ZOÖLOGY.[1]

THE RIGHT WHALE OF THE SOUTHERN EUROPEAN SEAS.—Prof. Gasco, of Genoa, has recently published, through the Royal Academy of Sciences of Naples, a full description of the external and internal characters of a right whale which was taken near Taranto, in 1877. This specimen was regarded by Dr. Capellini as representing a species new to science, which he named *Balæna tarentina*. Prof. Gasco has concluded on the other hand that it is a specimen of the *B. cisarctica* Cope, thus confirming the supposition of Prof. Cope that the species of the eastern coast of North America is identical with that of the Gulf of Biscay. The specimen is not adult, and of about the same age and size as the one captured near Philadelphia about 1864.

M. Fischer, of Paris, after a study of the remains and descriptions of the whales of the Temperate and Southern European coasts within his reach, has found the following to be related forms: The *Balæna cisarctica* Cope, and the Saw of the American coast; the Nordkaper and *Balæna biscayensis* of the European coast; the *Hunterius temminckii* Gray, of the Cape of Good Hope, and the subfossil *Hunterius swedenborgii* Lillj., of Gothland and *Balæna lamanoni* of Paris. He concludes that these are not all identical, but belong to two divisions, perhaps of one species each, which are characterized, the one by the very small head, bifid first rib, and the very thick and almost cylindrical inferior extremities of the ribs; the second by a larger head, simple first and flattened following ribs. To the former belong the *Hunterii* and the *B. biscayensis*; to the latter the *A. cisarctica* and the Saw.

A NEW SPECIES OF GORILLA.—An adult female of a species of Gorilla was received in Paris about a year ago, and became the

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

subject of a comparative study by MM. Alix and Bouvier. These naturalists became convinced that the animal belongs to a species distinct from the *G. savagei*, which they named in a communication to the Academy of Sciences, *G. mayema*. Its principal characters are seen in the spines of the anterior cervical vertebra, which are much less elevated than in *G. savagei*, and in the greater approximation of the orbits, and prominent acute ridge of the middle line of the interorbital region. The species is smaller than the gorilla, about equaling the chimpanzee. Various other characters are mentioned by MM. Alix and Bouvier, the value of which is as yet uncertain. The cranial crests are highly developed. The typical specimen was obtained on the coast of Quilo in Congo.

THE HERPETOLOGY OF NEW GUINEA.—Dr. H. E. Sauvage has recently given in Bulletin of the Société Philomathique of Paris, a list of the reptiles of New Guinea known up to the present time. He enumerates of *Testudinata*, 3 species; of *Lacertilia*, 46 species, divided among the families as follows: *Gecconidæ*, 12; *Agamidæ*, 6; *Varanidæ*, 5; *Scincidæ*, 23. Of *Ophidia* there are 34 species, divided as follows: *Scolecophidia*, 2; *Peropoda*, 6; *Colubroidea*, 17; *Proteroglypha*, 9. The most noteworthy facts are: First, the absence of Solenoglyph serpents, as in Australia (See Proceedings Academy Nat. Sciences, Philadelphia, 1859, on *Acanthophis*). Second, the genera *Erebophis* and *Chondropython*, the latter resembling some of the *Boidæ* in several respects. Third, the large number of *Scincidæ*, and (4) *Gecconidæ;* (5) the presence of *Platemys* as in Australia.—*E. D. Cope.*

A MONSTROUS FROG.—Mr. Jacob Stauffer, the veteran naturalist of Lancaster, Pa., sends me a drawing of a frog (*Rana palustris*) with a well developed extra hind limb or what appears from his drawing and description to be, speaking more correctly, a united pair of hind limbs, though occupying an asymmetrical position, and having their true homologies to a certain extent concealed from this cause. A sketch and remark of Mr. Stauffer's, however, show the true nature of this limb to be compound, that is, that it consists of two united halves derived by development from both sides of the body. He remarks: "The extra leg is of the same color above and below, whilst the other or normal legs are of a dirty yellowish color beneath." He further says this leg has six instead of five toes, and gives a sketch which leads me to think that the digital formula of the compound foot must be written in this manner: 5, 4, 3, 3, 4, 5, showing clearly that the limbs are fused together by their inner faces, thus bringing the outer or fourth and fifth toes to the outside, whilst the prevalence of the superior and outer dark colors, and concealment of the inner and inferior yellow tints, is just what ought to happen in the event of such union.

Altogether it is a very interesting case of the development of additional limbs, and is probably of commoner occurrence than is generally supposed. Its origin is probably to be attributed to injury or shocks, the same as that of monsters in general, as has been shown by direct experiment on eggs, and as I have been led to believe from the numerous cases where additional tails or branches arise from the original organs of lizards when broken off or injured. It may be the working of some atavismic tendency, where the organism is making an effort to return to some remote ancestral form, an explanation which will not answer, however, with respect to the lizard's tail. The theory of the archipterygium may explain it.—*Jno. A. Ryder.*

THE COCOONS OF MICROGASTER.—In examining the Microgaster which infests the different species of Macrosila, I have noticed several points in the spinning of the cocoon which are different from what are described in the very interesting note in the August number of the NATURALIST.

Never having studied those which are found upon the Philampelus, I do not know to what extent, if any, the parasites of the potato worm differ from them in structure.

First, as the worm issues from the body of its host, it does not assume the erect position even for a moment, but remains flexed, with its head ready to begin spinning as soon as the last segments of the body appear. There is, apparently, no envelope to the body, and the first active movements are those of the head as it fixes the preliminary stay threads previous to spinning in the regular loop form. This goes on precisely as described in the note referred to until the worm has finished one side, has turned upside down and is ready to complete the other half of its case. Then, instead of beginning to spin at the bottom, it quickly flexes its body, thus bringing its head back to the "toe of the slipper," from which it spins downward till the back of its host is reached and it is entirely enclosed.

The spinning of the two sides of the cocoon, then, is practically upon the same plan. In the first half the straightening of the bent body proceeds from below upwards, in the second, from above downwards. The position of the extremities is, of course, reversed in the two instances. The second position, though apparently a difficult one to assume, is nevertheless easily taken by the worm, no matter what may be its position upon the body of its host. The time required for completing this envelope is from thirty to forty-five minutes. In the further lining and completing the cocoon the worm can be seen to turn about four times before the structure becomes opaque.—*Wm. A. Buckhout.*

CETONIA INDA INJURING CORN.—This common and generally harmless beetle is reported by Mr. C. B. Smith, of Granby, Mass., to be injurious to corn. He sends us a specimen which he says,

"was found under the husk of an ear of corn. I found twenty about one ear, and have seen them about corn in several places in this garden. Several were found with their heads buried to the bottom of a kernel of corn, and bodies standing out from the ear. I think it is the same insect as is found in Pittsfield, South Hadley, Newton, Conway and other places, and called the 'corn bug' in our papers."

ANTHROPOLOGY.[1]

CRANIA UTILIZED AS CINERARY URNS IN A BURIAL MOUND IN FLORIDA.—In opening a burial mound at Cade's Pond, a small body of water situated about two miles northeastward of Santa Fe Lake, Florida, the writer found two instances of cremation, in each of which the skull of the subject, which was unconsumed, was used as the depository of his ashes. The mound contained besides a large number of human burials, the bones being much decayed. With them were deposited a great number of vessels of pottery, many of which are painted in brilliant colors, chiefly red, yellow and brown, and some of them ornamented with indented patterns, displaying not a little skill in the ceramic art, though they are reduced to fragments. The first of the skulls referred to was exhumed at a depth of two and a half feet. It rested on its apex (base uppermost), and was filled with fragments of half-incinerated human bones mingled with dark-colored dust, and the sand which invariably sifts into crania under such circumstances. Immediately beneath the skull lay the greater part of a human tibia presenting the peculiar compression known as platycnemism to the degree of affording a latitudinal index of .512; while beneath and surrounding it lay the fragments of a large number of other human bones, probably constituting an entire individual.

In the second instance of this peculiar mode in cremation, the cranium was discovered on nearly the opposite side of the mound, at a depth of two feet, and, like the former, resting on its apex. It was filled with a black mass—the *residuum* of burnt human bones mingled with sand. At three feet to the eastward lay the shaft of a flattened tibia which presents the latitudinal index of .527. Both the skulls were free from all action of fire, and though subsequently crumbling to pieces on their removal, the writer had opportunity to observe their strong resemblance to the small orthocephalic crania which he had exhumed from mounds in Michigan The same resemblance was perceptible in the other crania belonging to this mound. The small, narrow, retreating frontal, prominent parietal protuberances, rather protuberant occipital, which was not in the least compressed, the well-defined supraciliary ridges, and the superior border of the orbits presenting a quadrilateral outline, were all particularly noticed. The lower facial bones including the maxillaries were wanting.

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

On consulting such works as are accessible to him, the writer finds no mention of any similar relics having been discovered in mounds in Florida or elsewhere. For further particulars reference may be had to a paper on the subject read before the St. Louis meeting of the American Association, August, 1878.—*Henry Gillman, Waldo, Florida.*

ANTHROPOLOGICAL NEWS.—The eleventh annual report of the Peabody Museum of American Archæology and Ethnology is the most important contribution to anthropology that has appeared during the year, either in this country or in Europe. The Trustees having completed the new building for the museum, the inaugural exercises are fully reported in the volume. The titles of the scientific papers are: Second Report of the Implements found in the Glacial Drift of New Jersey, by C. C. Abbott; The Method of Manufacture of Several Articles by the former Indians of Southern California, by Paul Schumacher; Cave Dwellings in Utah, by Edward Palmer; The Manufacture of Soapstone Pots by the Indians of New England, by F. W. Putnam; Notes on a Collection from an Ancient Cemetery in Southern Peru, by John H. Blake; Archæological Explorations in Tennessee, by F. W. Putnam; Observations on the Crania from the Stone Graves in Tennessee, by Lucien Carr; On the Tenure of Land among the Ancient Mexicans, by Ad. F. Bandelier. The paper of Mr. Abbott is a continuation of the one contributed to Vol. X upon the evidences of the pre-glacial, or intraglacial existence of man in New Jersey. Whatever may be the true interpretation of the facts set forth by Mr. Abbott, we are confident that the day has gone by when evidence of this kind will not receive a patient and unprejudiced hearing. Two separate questions spring out of these researches, viz.: whether the implements are of human manufacture, and whether the beds in which they lie are related to the so-called Glacial Age. The explorations of Mr. Putnam, in Tennessee, were crowned with signal success, and the construction of the mounds and graves, together with the contents human and depository, have enabled him to classify the people who constructed them and lie buried in them. The supplementary article by Mr. Carr upon the crania adds greatly to the value of Mr. Putnam's paper. The contribution of Mr. Bandelier is supplementary to his paper on the Art and Mode of Warfare of the Ancient Mexicans in Report X. The author belongs to the Morgan school of critics, holding that the descriptions of the chroniclers of the sixteenth century interpreted savage society in the light and language of their own countries. The author exceeds Mr. Morgan in the justice of his appreciation of the motives of the old authorities. His command of authorities is immense; but his use of them is often painful to the reader, as for instance his reference to Sr. Icazbalceta's "Col. de Documentos," and other rare and precious works,

the only copies of which in the United States perhaps are in the private library of Mr. Bandelier. The conclusions of the paper are:

1. The notion of abstract ownership of the soil, either by a nation or State, or by the head of its government, or by individuals, was unknown to the ancient Mexicans.

2. Definite possessory rights was vested in the kinships composing the tribe; but the idea of sale, barter, or conveyance or alienation of such by the kin had not been conceived.

3. Individuals, whatever might be their position or office, without any exception, held but the right to use certain defined lots for their sustenance, which right, although hereditary in the male line, was nevertheless limited to the conditions of residence within the area held by the kin, and of cultivation either by or in the name of him to whom the said lots were assigned.

4. No possessory rights to land were attached to any office or chieftaincy. As members of a kin, each chief had the use of a certain lot, which he could rent or farm to others, for his benefit.

5. For the requirements of tribal business and of the governmental features of the kinship (public hospitality included) certain tracts were set apart as official lands, out of which the official households were supplied and sustained; but these lands and their products were totally independent from the persons or families of the chiefs themselves.

6. Conquest of any tribe by the Mexicans was not followed by annexation of that tribe's territory, nor by an apportionment of its soil among the conquerors. Tribute was enacted, and for the purpose of raising that tribute (in part) special tracts were set off, the crops of which were gathered for the storehouses of Mexico.

7. Consequently, as our previous investigation (of the warlike institutions and customs of the ancient Mexicans) have disproved the generally received notion of a military despotism prevailing among them, so the results of this review of tenure and distribution of lands tended to establish, "that the principle and institution of feudality did not exist in aboriginal Mexico."

In *Nature*, for August 22d, is a review, by Mr. W. B. Dawkins, of a work entitled, "British Barrows; a record of the examination of Sepulchral Mounds in various parts of England, by William Greenwell, M.A., F.S.A., together with Description of Figures of Skulls, General Remarks, Prehistoric Crania and an Appendix. By George Rolleston, M.D., F.R.S. The observations of Mr. Dawkins are so practical, and the results resemble so nearly many of our own remains that we give a lengthy extract from his review:

"The barrows vary in size and shape very much as the graves and tombs in our own graveyards, where the rich man's memory is preserved by the large mausoleum, while the poor man's resting place is marked merely by the little mound of earth, soon to be lost in the general surface. Those in the Yorkshire wolds are

either circular or 'long,' the former being the more abundant, and are frequently surrounded by a *ramp* or a ditch. In some cases this was within the base of the barrow, and very generally it was incomplete. 'This very remarkable feature,' writes Mr. Greenwell, 'in connection with the inclosing circles, is also found to occur in the case of other remains which belong to the same period and people as the barrow. The sculptured markings engraved upon rocks, and also upon stones forming the covers of urns or cists, consist in the main of two types, cup-shaped hollows and circles, more or less in number, surrounding in most cases a central cup. In almost every instance the circle is imperfect, its continuity being sometimes broken by a duct leading out from the central cup; at other times by the hollowed line of the circle stopping short when about to join at each end. The connection of the sculptured stones, if so they may be termed, with places of sepulture brings them at once into close relationship with the inclosing circles of barrows, and it is scarcely possible to imagine but that the same idea, whatever that may have been, is signified by the incomplete circle in both cases. The rings of gold and bronze, of various shapes, some of which in their construction show that the penannular form is not caused by the requirements of their use, appear to represent the same incomplete circle. In fact, if some of the gold rings were figured upon stone they would appear in the very similitude of the circular rock sculptures.' Our author suggests that it may have been intended to prevent the exit of the spirits of those buried, though in that case it is hard to see why the spirit should not have found its way out through the opening. It seems more probable that if the barrow represented the hut inhabited by the living that the circle round it would represent the trench, or the inclosure of the hut, and that this would necessarily be incomplete to allow of access to the habitation. The dead were buried in the barrows of the wolds, very generally in the condition and clothing in which they died, the proportion of cases of inhumation to those of cremation being as 301 to 378, or about 80 per cent. In all probability both customs were carried on simultaneously, as was the case in ancient Rome, where, however, inhumation was mainly confined to the lower classes. Where inhumation had been practiced the body was buried in the crouching position in which life had departed, and which would be natural where the sleeping place was not well protected against the cold, and the covering was scanty. This interpretation, due to the ingenuity of Mr. Evans, is most likely true. The burnt and broken bones of various animals used for food, in the barrow, are probably the remains of funeral feasts, held at the time of the interment, or from time to time afterwards, or they may be the remains of food offered to the dead. Splinters and various manufactured implements of flint and fragments of pottery also occur sometimes in

great abundance, and probably symbolize some religious idea. Fragments of flint were used in interment at least as late as the fourth and fifth century after Christ in this country; for they were found in considerable quantities inside the oaken coffins in the Romano-British cemetery, referable to the above date, explored at Hardham, Sussex, in 1866. Where cremation was practiced, the funeral pile was sometimes kindled upon the spot, which was afterwards occupied by the barrow, but at other times the ashes of the dead were collected and deposited somewhere else. In several barrows curious perforated vessels of pottery, or 'incense cups' were met with, which may have been used to convey the sacred fire to the pile. The ashes of the dead were placed in urns sometimes highly ornamented, and those things which delighted the dead most, or were most useful to him, were deposited in the tomb. Flint scrapers, flakes, arrow-heads, beads, hammer axes, celts, domestic pottery and a few bronze articles. The number of objects buried in each barrow varied according to the wealth of the dead and the estimation in which he was held by the survivors.

"The animal remains in these barrows proved that the ancient inhabitants of the wolds were no rude savages, living mainly on the chase. They possessed flocks and herds, consisting of well known domestic breeds—the small Celtic short-horn, now represented by the mountain cattle of Wales and Scotland, the pig, the horned sheep or goat, the horse and the dog, the two last being the rarest. They also ate venison of the stag (*Cervus elaphus*). Their place in the archæological scale of culture is fixed by the few and simple forms of bronze articles in the barrows. The simple wedge-shaped axe and the short, broad dagger, in association with various articles of stone, coupled with the absence of the higher bronze types, such as the sword. They belonged to the early bronze age. The absence of the sword is also noticed in the tumuli of France, referred by M. Chantre to the same horizon. At this time the knowledge of bronze was gradually finding its way northwards from the Mediterranean centres, and the simpler forms preceded the more complex and elaborate.

"Nor are we left in doubt as to the ethnical relations of these ancient Yorkshiremen. Prof. Rolleston's elaborate examination of the crania and skeletons reveals the fact that two types, the small long-headed "Iberian" and the tall, robust round-heads, or "Celtic," which have been traced by Thurman, Huxley, Busk and myself, from Scotland to the Mediterranean, and from the Rhine to the Pillars of Hercules, occur in the round barrows side by side in intimate association. The former of these 'the Silurians' of Prof. Rolleston, is considered in this work as the older of the two. According to Dr. Thurman it was dormant in Britain in the neolithic age, at the close of which it was invaded by the

"Celtic" or "Cimbric" of Prof. Rollesten. The truth of this view is confirmed by the fact that the dead of these two races rest peacefully together in the round barrows of the wolds referable to the early bronze age.

"In concluding this review it remains merely to say that this valuable work fills a void in the archæological record of Great Britain, and it contains a larger mass of accurately observed facts than any book hitherto published relating to the bronze age in this country."

Rev. Stephen Bowers, Ph.D., is continuing his explorations in Southern California this summer, with head-quarters at Santa Barbara. His researches fully sustain Mr. Stephen Powers' estimate of the vast number of aborigines once inhabiting the Pacific coast. Between Point Rincon and Point Conception, a distance of seventy miles along the coast, Mr. Bowers has explored nearly seventy (70) Pueblos or sites of old Indian towns, and about thirty on the Santa Iñez river. In one burial place on this river he obtained 240 fine specimens consisting of mortars and pestles of sand-stone; bowls, pipes and "charms" of serpentine; ollas and tortilla stones of crystallized talc; spear-points and arrow-heads manufactured from chert, etc., etc. Besides these specimens he obtained nearly half a bushel of beads and ornaments from stone, bone and shells. Near Guadaloupe Mr. Bowers obtained from a single pueblo over 1800 specimens in stone. These consisted of bowls and pestles from granite, sandstone and serpentine; mano stones used in grinding; balls, knives, drills, tools, spear-points, arrow-heads, scrapers, etc., from chert; sinkers finely wrought from serpentine and talc, etc., etc. Dr. Bowers and his wife discovered these antiquities on the mainland nearly four years ago, since which they have shipped several tons of fine specimens to enrich the National Museum. Mrs. Bowers accompanies her husband in all his researches, and is herself an indefatigable collector.

Attention is called to the following titles: Folk-lore on Wells and Water, A. Fraser, *Celtic Magazine*, August 8; Japanese Mythology and Religious Worship of the Ancients, *Westminster Review*, July; Mound Builders, were they Egyptians, and did they occupy the State of New York, *Mag. of Am. Hist.*, September; Palæographie Américaine. Dichiffrement de l'Ecriture Maya, H. de Charency, *Annales Philosophie Chiétienne*, July 14; A Comparison of the Pueblo Pottery with Egyptian and Grecian Ceramics, A. S. Barber, *American Antiquarian*, I, 2, July; Brewing in Japan, *Nature*, September 12th.

FOREIGN.—The Anthropological Institute of Great Britain and Ireland has lately devoted a whole session to the discussion of the antiquity of man. Professor Boyd Dawkins read on this occasion a long paper on the caves of Great Britain, among which he selected those of Cresswell as typical examples. In these caves, Robin

Hood's and Church Hole, palæolithic utensils have been found in corresponding situations. The bottom of the caves is covered with a layer of light-colored sand, doubtless the result of the decomposition of the rock. Next follows a stratum of red sand and clay of about three feet thickness, containing fragments of stones and bones of extinct animals, usually broken and gnawed by hyenas which had brought them to their dens. The sand and the clay bear witness to inundations which reached a height of at least twenty feet above the present water-level. The osseous remains belong to the following species: Lion, spotted hyena, fox, wolf, bear, reindeer, Irish stag, aurochs, horse, rhinoceros, mammoth, and hare. The presence of man is revealed by some rudely worked quartzite flakes, which suffice to demonstrate that savages of a very low order contended from time to time for the possession of the caves with hyenas, which came back again when the human occupants had left. The association of these heterogeneous *débris* in this deposit is thus accounted for. It was covered by a stratum of red, loamy earth, the upper portion of which passed over into a calcareous breccia. Here numerous fragments of bones, either gnawed by hyenas, or broken and scratched by man, was intermingled with charcoal and calcined bones, and with implements of quartzite and flint representing forms known in Great Britain and on the Continent. Some were identical with those found in the gravel-beds of Brandon, Bedford and Hoxne, and of Saint-Acheul and Toulouse. All these occur associated with the remains of the mammoth, the reindeer and rhinoceros. The layer enclosed flakes, blades, scrapers, perforators and spear-heads resembling those of Solutré. There were also awls and needles of bone, and with the worked bones was found a rounded and polished piece of a rib on which an outline drawing of a horse is traced. This specimen reminds one of similar discoveries in French and Swiss caves. The fauna comprises the following species: Machairodus, lion, wild-cat, leopard, spotted hyena, fox, wolf, bear, reindeer, Irish stag, aurochs, horse, rhinoceros, mammoth and hare. A crust of stalagmite, about a foot in thickness, rested upon this layer. The distribution of the objects found in the Creswell caves points to three successive periods of human occupancy. The red sand contained a few rude implements of quartzite. In the lower deposit of the red loamy earth the chipped objects consisted of quartzite and flint, the latter occurring not nearer than forty miles from this locality. In the upper part of the same layer quartzite disappears almost entirely, and is replaced by numerous flint implements. Here was also found the engraving of a horse, and by far the greater number of bone tools. Such a successive series, Professor Dawkins thinks, has not yet been met with either in England or on the Continent. It shows a marked progress in the mechanical arts of the cave-dwellers, while the fauna has remained unchanged.

Professor Dawkins drew particular attention to the promiscuous character of the bones found in palæolithic cave-deposits. These bones belong to extinct or still living northern and tropical animals, and to such as pertain by their nature to moderate climates. In explanation of this fact he says: "There existed in those times a vast continent contiguous to Africa, and stretching as far as the extreme limits of Ireland and Scotland. In summer the lion, sabre-toothed tiger, spotted hyena and hippopotamus went northward, while during winter the reindeer, musk-ox, lemming, tailless hare, glutton and Arctic fox sought refuge in the South." The mixed bones of these animals, he states, show no difference in their chemical composition, which certainly would not be the case if long periods had intervened between the time of their existence. The views of Mr. James Geikie, as given in his "Great Ice Age," were strongly opposed by the lecturer. The May number of the *Matériaux pour L'Histoire Primitive et Naturelle de L'Homme* contains a long and highly illustrated review of the splendid work by Mr. Ernest Chantre, relating to the Bronze Age of the Rhône district. A copy of the large map accompanying that work is presented to the readers of the *Matériaux*. This map embraces France and the adjacent parts of Germany and Switzerland. All points of archæological interest, such as caves, palafittes, tumuli, dolmens, etc., are indicated on it by different signs, denoting by their colors the probable age to which each locality pertains.

The Proceedings of the Berlin Anthropological Society for 1877 (*Verhandlungen der Berliner Anthropologischen Gesellschaft*) were lately received. On the 7th of April the Anthropological Society, in conjunction with the Geographical Society of the same city, gave a reception to the Emperor of Brazil. On this occasion Professor Virchow delivered a long and interesting address on the anthropology of America. A translation into English would be very desirable.

GEOLOGY AND PALÆONTOLOGY.

THE REPTILES OF THE UPPER JURASSIC OF THE NORTH OF FRANCE.—Dr. H. E. Sauvage has described in the *Bulletin* of the Geological Society of France a description of some bones of the limbs of a Sauropterygian reptile, which he refers to the genus *Polycotylus*, under the name of *P. suprajurensis*. A Dinosaurian of the same horizon he refers to the genus *Iguanodon*, under the name of *I. precursor*. Dr. Sauvage adds to the list the previously known species, *Megalosaurus insignis* Desl., *Omosaurus armatus* Ow., and *Bothriospondylus suffossus* Ow., all *Dinosauria*. He obtains *Megalosaurus*-like teeth from the Gault of the Meuse and of Ardennes.

A QUATERNARY CAMEL FROM ROUMANIA.—Professor Stephanesco, of Belgrade, recently communicated to the Geological

Society of France a specimen of an almost entire lower jaw of an extinct species of camel found in a quaternary deposit in Roumania. Remains of probably the same species have been found in Hungary. It belongs to the genus *Pliauchenia* (Cope), a form hitherto only known as American, which is intermediate between the genus *Camelus* and the *Procamelus* of Leidy. The species was rather smaller than the *Camelus dromedarius.*

THE FAUNA OF THE LOWEST TERTIARY OF FRANCE.—Below the lignite and argile plastique of Meudon, where the greater number of types of the Suessonien Fauna have been discovered, several horizons of the Lower Eocene are recognized in France. Immediately below the argile plastique is the conglomerate of Meudon and Cerny, and, still lower, the Sables de Bracheux. The latter is the first horizon above the upper bed of cretaceous, or the Pisolitique, which is perhaps to be parallelized with the Mæstrichtien.

Dr. Lemoine has recently investigated the vertebrate fauna of these beds with much success. I give a brief notice of his discoveries, which are of much interest to American palæontologists, in view of the light they throw on the faunæ of the corresponding periods of the history of our continent.

In the Sables de Bracheux he finds peculiar Squalodonts, and a new species of the genus *Myledaphus*, thus far only known from the Laramie bed of the Judith river of Montana. Also a *Chimæra* like the *Mylognathus* of Leidy; a gar of the genus *Clastes* Cope, which is shown to be quite distinct from *Lepidosteus* in the entire maxillary bones, and Lacertilia.

In the conglomerate, Dr. Lemoine finds *Mammalia* related to *Adapis*, viz: *Lophiocharus copei* Lem., and two species of *Plesiadapis* Gerv.; also two species of *Arctocyon* and a new genus, *Pleuraspidotherium.* With these occur in abundance, the remains of the genus *Champsosaurus* (Cope *Simædosaurus* Gerv.) *lemoinei* Gerv, which is well known as characteristic of the American Laramie group. Crocodiles and alligators are abundant, with turtles of the genus *Compsemys* Leidy. There are numerous squalodonts, and a large species of *Pappichthys* Cope, a genus of *Amiidæ* which first appears in America in the Bridger formation.

The greatest number of species were found by Dr. Lemoine in the Sables and other beds of the horizon of the Lignite of Meudon, or nearly that of the *Gastornis*, the *Palæonyctis*, and the *Coryphodon eocænus.* The following names of genera of mammalia recall the Wasatch and Bridger fauna of America. *Phenacodus*, *Hyracotherium*, *Opisthotomus*, *? Hyopsodus*, *? Stypolophus*, *Miacis*, and the *Lophiocharus peroni* and three species of *Plesiadapis* Gerv., *Orotherium* (Cope), *Pachynolophus*, *Lophiodon* and one or two Artiodactyles. Crocodiles, *Ophidia* and *Lacertilia* are more abundant, with birds and turtles. The genera of the latter are very familiar on this side of the Atlantic; *Polythorax* Cope, a *Dermate-*

mys near *costilatus; Anostira* Leidy, *Tronyx;* a form much like *Plastomenus lachrymans* and a genus near to *Compsemys* Leidy, perhaps the *Apholidemys* of Pomel. Of fishes, *Pappichthys* is abundant, mingled with the marine genera *Myliobates*, *Phyllodes* and Squalodonts.

The above lists present a mixture of the Laramie, Wasatch and Bridger fauna of Western America. It is remarkable that of the first named, only those of Tertiary character have been found by Dr. Lemoine, since the numerous types of *Dinosauria*, are entirely wanting.—*E. D. Cope.*

GEOGRAPHY AND TRAVELS.[1]

Lake Nyassa.—Mr. H. B. Cotterill has recently returned to England, after an absence of nearly two years, during which he explored the Nyassa lake and also made the journey from its northern end to Dar-es-Salaam (on the coast twenty-five miles south of Zanzibar), a distance of 350 miles, passing through a region never before visited by Europeans.

From a paper read before the Royal Geographical Society, on the 25th of March, and a lecture delivered at the Society of Arts, on May 27th, and reported in the *Times*, we learn that the principal object of his journey was to endeavor to plant in Central Africa, a germ of legitimate commerce and thus assist in the destruction of the slave trade. Mr. Cotterill sketched the suppression of this traffic on the coast line, and stated that the word "suppression" exactly expressed the circumstances of the case. This trade is now scotched but by no means dead. Were the pressure put upon the trade now relaxed, slavery would again revive. Footholds and centres for civilizing influences in the interior must be secured before it can receive its death-blow. The advantages which the Nyassa offered for commencing beneficial influences upon the interior were, that there existed a great lake settlement; the accessibility of the Nyassa both by land and water, as compared with other lakes; the magnificent water-way supplied by the Nyassa, itself, to the very heart of the continent, and the commanding position that any settlement at the north end of the Nyassa would hold. He found the northern portions of the lake far more beautiful and populous than the granite country of the south. Ivory is in abundance. There was evidence of the presence of precious metals. Cotton grew wild and was also cultivated by the natives. Sugar cane, grains of various kinds, yams, bananas and the like grew luxuriantly. The region was as healthy as India when once a person had become acclimatized.

His journey to the coast was made in company with Capt. Elton, late British Consul at Mozambique, and three friends. From the northern end of the lake a flat marshy country extends towards the southern end of Tanganyika which was said to be

[1] Edited by Ellis H. Yarnall, Philadelphia.

about ten or twelve days distant. After a few days march they reached a great plain bounded by a range of mountains called Kondi, running from the eastern side of the lake to the north-west. Several rivers intersect the plain running towards the Nyassa and it is a country of remarkable beauty and fertility. By a gradual ascent the height of 6000 feet above the sea was reached. Finally, passing through forests of gigantic bamboos, they crossed the Kondi range at a height of 8800 feet above the sea, and found themselves on a great plateau 7000 feet high called Uwanji, a splendid cattle country. Here they soon came to Merere's town. From this point other plains intersected by many streams could be seen. They suffered much during the remainder of the journey from scarcity of food and shortly before reaching the Ujiji caravan route, 350 miles from Bagamoyo, Captain Elton, who had been failing rapidly, died.

The rest of the party arrived safely at Zanzibar, after a journey of four months and a half from Livingstonia. A full account of the journey, under the title "Researches and Adventures among the Lakes and Mountains of Eastern Africa," will soon be published.

A direct road from Dar-es-Salaam to the lake has already been begun at the expense of one or two private persons. The Royal Geographical Society has decided to dispatch a carefully-organized expedition commanded by Mr. Keith Johnston to explore this region, and contemplates pushing their explorations to the southern end of Lake Tanganyika, a further distance of 190 miles. The expedition is expected to leave England early in November. Some weeks will be spent in scientific investigation in the coast regions near Zanzibar. A geologist has been appointed as assistant and second in command to Mr. Johnston. The route to Livingstonia, the Scotch Mission settlement at the southern end of Nyassa, is being improved by the opening of the rivers Zambesi and Shire by the Portuguese to steam navigation, and the making of a road for seventy miles around the rapids of the Shire to a point whence the steamer *Ilala* runs to the new colony.

In connection with the remarks of Mr. Cotterill it may be stated that the transport of slaves by sea is being rapidly crushed out by the exertions of the British fleet engaged in that service on the east coast of Africa. During the last half of 1877 only nineteen slaves were captured, while in the previous six months the number was 263. Two years ago the computed average of slaves introduced into Pemba amounted to 1000 a month, but not more than 800 are believed to have been landed during the last six months of 1877. The caravans sent down to the coast are very small; many were captured and others returned to the interior, no market being found for them.

A meeting of geographers and telegraph engineers was

recently held in London to consider the connection of the Egyptian telegraph lines now reaching Khartum with those existing at Kimberley in the extreme south of Africa. The Central African Telegraph Company are already making arrangements to run a line from the Transvaal to Zanzibar.

OBITUARY.—Dr. August Heinrich Petermann died at Gotha, on the 26th of September. This very eminent geographer was born at Bleicherode, a village of Prussian Saxony, April 18, 1822. Educated at the Potsdam Geographical Institute, founded by Berghaus, the well known author of the "Physical Atlas," he afterwards became his secretary and assistant in preparing the maps for his great work, and also for that of Alexander von Humboldt on Central Asia. Removing to Edinburgh in 1845, and afterwards to London, he aided largely in the bringing out of Dr. A. K. Johnston's "Physical Atlas" and other geographical works, took an active part in the proceedings of the Royal Geographical Society, and was instrumental in sending Drs. Barth, Overweg and Vogel to Central Africa. In 1854, he undertook the charge of the great geographical establishment of *Justus Perthes*, at Gotha, where he remained until his death, founding and conducting with great success the *Mittheilungen aus Justus Perthes' Geographischer Anstalt über Wichtige neue Erforschungen auf dem Gesammtgebiete der Geographie*, a monthly periodical whose volumes constitute an almost complete record of the progress of geographical discovery since that date, illustrated by a vast number of maps and plans. The first and second North German Expeditions to the North Pole were sent out under his direction and material support. The new edition of Stieler's "Hand-Atlas" (1875), contains many maps drawn by him, including the best, for their size, that have yet appeared of the western portion of the United States. The loss, at a comparatively early age, of one whose untiring industry and enthusiastic devotion has so greatly aided in extending the bounds of civilization, is deeply deplored.

MICROSCOPY.[1]

NATIONAL MICROSCOPICAL CONGRESS (*Continued*).—"The Migration of Leucocytes," by Dr. W. T. Belfield, of Chicago. In examining microscopic sections of the kidneys of persons who had died of pneumonia, the author had found the intertubular tissue crowded with an abundance of cells having all the appearance of white blood corpuscles. As other appearances of renal inflammation were wanting, and there had been no previous history of renal disease, it was judged that the retardation of the blood current incident to the pneumonia had furnished the occasion for the escape, from the capillaries, of the blood corpuscles by means of their amœboid movements. To test and study this fact of migration of leuco-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

cytes in passive hyperæmia, frogs were curarized, the femoral vein exposed by dissection, and pressure applied by means of an India rubber band and a plug of cork. The web of the corresponding foot was stretched upon the stage of the microscope, and the pressure upon the vein regulated so as to retard the current of blood without producing complete stagnation. That the effects produced were due to passive and not to active hyperæmia, to mechanical congestion and not to inflammation, is shown by the absence of other phenomena of inflammation, and by the fact that discontinuance of the pressure on the vein was immediately followed by full restoration of the circulation. In one instance, migration was observed within three hours after compression was made, but in others no migration was detected within the first nine hours. Sooner or later, in all cases, leucocytes were seen to leave the vessels in considerable numbers, not usually from the minutest capillaries but from the large capillaries and small veins of from $\frac{1}{1500}$ to $\frac{1}{1600}$ of an inch in diameter. Emigration also occurred where the currents were rapid and sparsely supplied with corpuscles, as well as from slow currents crowded with corpuscles. The time of exit averaged from one to two hours, but was sometimes as short as twenty minutes. The method of locomotion did not, of course, differ from that exhibited in inflammation, though excessive change of form, and protrusion of long processes, was not noticed. Frequently a leucocyte flattened against the wall, then a bud appeared external to the wall, and the intra-vascular portion gradually shrank away as this bud increased in size. Often the locomotion was continued after the leucocyte had wholly left the vessel, so that it traveled several times its own diameter from the place of exit. Other corpuscles, too, were prone to pass out at the same point, so that sometimes several would be crowded together within the vascular wall, and an hour later would be in close proximity external to the vessel opposite the same point. Certain red corpuscles of the same shape and size, and without a nucleus, but of unmistakably red color, were frequently seen to migrate in a similar manner, and to such an extent that after thirty-six hours there were many patches in the field which looked almost like hemorrhages. That they were not hemorrhages was inferred, because many of them had been seen to migrate, because they were fixed in the tissue, and not floating in the blood serum, and because they were all small and round, and different from the large, oval, nucleated red corpuscles of the animal experimented upon. This behavior of the small red corpuscles exhibits a close relation with the white, and furnishes another link in the chain of circumstantial evidence that the red corpuscles are transformed white ones. The facts observed would seem to favor the theory that the migration is a simple filtration of colloid substances, from increased blood pressure and diminished blood velocity, rather

than an active movement due to their "glutinosity." How far these facts account for the connective tissue hyperplasia which accompanies varicose veins, the enlargement of the spleen which usually follows portal obstruction, etc., depends upon one's ideas of pathogenesis.

"A Handy Rule for use in Micrometry," by C. M. Vorce, of Cleveland, described very clearly the methods adopted by the author in making miscropical measurements.

Professor Romyn Hitchcock, of New York, in a paper entitled, "A Standard Micrometer," urged the adoption of a standard which should give some uniformity in micrometric work by different observers. Efforts to secure this end have been made, years ago, but they seem to have led to no results. We are now as far from a definite standard as ever, and the question can only be settled by a representative body like this, or by one convened for the special purpose. Not only accuracy but uniformity is essential, for convenience in reading and comparing observations. A fraction of an inch might seem the preferable unit of measurement to us in this country, but it can never become universal. The metric system is the only one that can ever become universal, and we should now adopt it even at some temporary sacrifice of convenience.

Professor Rogers, whose facilities for accurate ruling have been greatly increased during the last few months, proposes to rule six scales, as nearly alike as possible, and donate five of them to the same number of microscopical societies, as standards, the societies having first appointed a committee to examine, compare, and approve the scales. (Near the close of the Congress, resolutions were offered by Professor Hitchcock, and adopted, recommending $\frac{1}{100}$ of a millimetre as our unit of micrometry, requesting microscopical societies to formally adopt this standard, and recommending to the favorable consideration of the societies, Professor W. A. Rogers plan for the acquisition and distribution of standard scales. This action was taken by the Congress without opportunity for discussion, and for the purpose of bringing the matter before the country for concerted action. It is possible that the unit suggested will need reconsideration, as one millimetre might be more convenient and more easily agreed upon than a nameless fraction).—(*To be Continued.*)

EXCHANGES.—Lake Michigan diatoms, mounted or raw material, also diatoms of Northern Illinois, for good slides or material. B. W. Thomas, 132 La Salle street, Chicago, Illinois.

Diatoms: Rhabdonema adriatica, Synedra ulna, splendens and superba, Tabellaria flocculosa, Fragilaria virescens, Isthmia nervosa, diatomaceous earths and other unmounted material, for named diatoms or other good mounted objects. M. A. Booth, Longmeadow, Mass.

Slides of named diatoms, also peristome of Funaria hygro-

metrica, offered in exchange. Jos. McKay, 24 Liberty street, Troy, N. Y.

A variety of interesting objects from the Bahamas, mounted or unmounted, for exchange. C. C. Merriman, Rochester, N. Y.

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SCIENTIFIC NEWS.

— We learn from the parties in the field in the Yellowstone National Park, that the work of Prof. Hayden's United States Geological Survey of the Territories has progressed most favorably despite the unsettled nature of the country, owing to the Indian troubles. The general features of the park have been exhaustively surveyed, an enormous amount of material in the morainal deposits and especially the structure of the Wind River mountains.

Meanwhile the reports of the survey, and particularly the Geological map of Colorado lately issued by this Survey, are winning golden opinions in Europe. A gentleman writes us from Paris as follows: "The Hayden Survey is popular in both England and France. I repeatedly heard expressions of regret that there should be any disposition to hamper or oppose it in any way. Such opposition would be looked on here as springing, without doubt, from unworthy motives." An elaborate notice by Mr. Oldham, the late distinguished director of the Geological Survey of India, appears in the *Geological Magazine*, in which the highest praise is given to the work. That all Americans should take pride in this great work and others of the kind, is made apparent by the favorable notices which have appeared in European journals. In letters lately received at the office of the survey, Prof. Andrew C. Ramsay, the veteran director of the Geological Survey of Great Britain, writes: "I have to-day received a copy of your Colorado Atlas, for which I am exceedingly obliged. I have all the maps, etc., spread out on one of the large drawing tables in the geological survey office, and have had a long look at them. The beauty of the engraving and coloring is most remarkable, and quite astonished me. I know nothing of the kind superior, or even equal to this work, especially when we consider the physical character of the country and the hardships that such a survey must entail. That so much has been done, and done in such a manner, speaks volumes for the energy and skill of you and all your men, and it is a credit to any government to have been the means of producing such a masterly piece of work."

Prof. Archibald Geikie, director of the Geological Survey of Scotland, writes: "Your magnificent Atlas of Colorado has just come. I have had time merely to look over the maps and sections in a cursory way. But I cannot delay to send you a few

lines of the heartiest congratulation on the completion of this most splendid contribution to science, and to the opening up of the resources of your great country. I shall take an early opportunity of going quietly over the maps and of speaking publicly about them. The care and elaboration of the original field-work, and the beauty of the execution of the plates, combine to make this atlas a national work of which any government might justly be proud."

We sincerely hope that Congress will certainly not decrease next year the amount of the annual grant for a survey, which, without disparagement to any other, has been conducted in such a broad as well as prudent spirit as to win golden opinions from those best qualified to judge of the manner of conducting such a survey.

— Prof. Cope has purchased the collections of vertebrate fossils exhibited by the Argentine Confederation at the Exposition of Paris. The collection embraces those of three exhibitors, and is one of the most extensive which has ever left Buenos Ayres. It includes 75 to 100 species, which represent all the more important types of the Pampean formation. There are twelve species of *Glyptodon*, and nineteen nearly complete skeletons of various forms. The most beautiful of these is that of a *Machærodus* similar to the Brazilian species. Prof. Cope retains a series of duplicates, some of them entire skeletons, for sale.

— NOTICE. Having removed from Salem to *Providence, R. I.*, the editorial office of the AMERICAN NATURALIST will be at the latter address, where all exchanges, articles, letters, and specimens designed for the editors may be sent. A. S. PACKARD, JR.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

SAN FRANCISCO MICROSCOPICAL SOCIETY.—The regular meeting was held July 11th. Of the business routine the most interesting part was the announcement of several donations and purchases for the library and cabinet. Rev. Mr. Bleasdale generously completed the suite of Dr. Carpenter's slides, already numbering eleven, by an addition of three more—shell sections of *Unio occidens*, *Anomia ephippium* and *Terebratula ampulla*.

The California State Geological Society presented specimens of "diatomite," from Santa Barbara, a flinty mineral supposed to have been deposited from silica-impregnated waters passing out

of a diatom earth, and Mr. Hanks sent some lichens containing diatoms from a parapet of the Palace at Versailles.

After examining the beautiful slides of foraminifera, mounted by Mr. Merriam and exhibited by President Hyde, the members began their contributions to the topic of the evening, "The microscopical examination of sea water, with reference to its animal and vegetable forms." Dr. Whitney spoke at some length of his physical and chemical investigations upon Pacific ocean water, taken at insetting tide just within the Golden Gate. He spoke of the lime and silica in solution in sea water, and beside attributing to these the origin of the foraminifera shells and diatom frustules, a well-known fact, spoke of the silica in solution as a probable source of sand, since he considered the fine deposit that gradually fell in his jars of sea water as coming from solution, and not as a long suspended silt, the view generally held.

After selecting for the next topic "The Lower Forms of Marine Life," the society listened to a translation, by Secretary Clark, of a short paper on "The Alternate Generation of the Echinodermata," by Prof. Haeckel.

American Association for the Advancement of Science.—The next meeting is to be held in Saratoga on the last Wednesday of August, 1879. The officers elected for that meeting are Prof. G. F. Barker, of Philadelphia, president; Prof. S. P. Langley, of Alleghany, Pa., vice-president of section A; Major J. W. Powell, vice-president of section B; Prof. Ira Remsen, chairman of subsection of chemistry and Prof. E. W. Morley, of Hudson, Ohio, chairman of subsection of microscopy. Among the noteworthy papers in geology and biology were those by C. O. Whitman on the Embryology of Clepsine, Prof. I. E. Todd's on Richthofen's Theory of the Loess in the light of the deposits of the Missouri, A. G. Weatherby's Are the so-called Chætetes of the Cincinnati Group Bryozoans? and his remarks on the Geographical Distribution of the land and freshwater Molluscs of the United States and their local varieties. Major Powell spoke on the rainfall of the arid region of the United States, while Prof. B. G. Wilder made a communication on a remnant of the spiracles in Amia and Lepidosteus, and S. A. Forbes read a paper on the development of Amia, Mr. C. E. Dalton made a communication on the geological history of the Colorado river and plateaus, and Mr. A. Lakes spoke of the discovery of Atlantosaurus and other Dinosaurs in the Rocky mountains of Colorado. The anthropological papers were noticed in our last number.

Boston Society of Natural History, Oct. 2d.—Mr. W. O. Crosby read notes on the physical geography and geology of Trinidad.

Appalachian Mountain Club, Oct. 9th.—Rev. H. G. Spaulding read a paper entitled Something about Moosilauk and the Franconia Range; Prof. J. H. Huntington gave an account of the Megalloway river and its physical and topographical features, while Mt. Ascutney, Vt., was described by Mr. Frederic Gardiner, Jr.

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SCIENTIFIC SERIALS.[1]

Proceedings of the Royal Geographical Society.—July 6, August 16, No. iv. On the Nyassa and a journey from the north end to Zanzibar (with a map), by H. B. Cotterhill. Travels in Western China and on the eastern borders of Tibet, by W. J. Gill. On the Geographical results of the Mission to Kashgar, under Sir T. Douglas Forsyth, in 1873–4, by H. Trotter. No. v contains the president's (Sir Rutherford Alcock) address. No. vi Geographical sketch of the Nile and Livingstone (Congo) basins, by H. M. Stanley. A lecture on plant-distribution as a field for geographical research, by Thistleton Dyer.

Siebold and Kölliker's Zeitschrift für wissenschaftliche Zoologie.—September 6. Contributions to a knowledge of the Julidæ, by E. Voges. On the formation of the blastoderm and the germinal layers in insects, by N. Bobretsky. Additions to a knowledge of the genus Brisinga, by H. Ludwig. Aspidura, a genus of mesozoic Ophiuridæ, by H. Pohlig. Fifth article on the structure and development of Sponges. The metamorphosis of *Sycandra raphanus*, by F. E. Schulze.

The Geological Magazine.—August. On the form of Volcanoes, by J. Milne. On a method of estimating the extent of Geological Areas, by T. M. Hall. September.—Notes on some Arctic Silurian fossils from Beechey island and from Port Dundas, Lancaster sound, by H. Woodward. Cataclysmic theories of Geological Climate, by J. Croll. Land plants in the Irish Silurians, by G. H. Kinahan. Wayside notes in travels over Europe: the great Northern drift, by R. Damon.

The Geographical Magazine.—September. The Treaty of Berlin (with a map). Richthofen on Prejevalsky's journey in Central Asia, Abyssinia. A new Survey of the Amazon. Indian irrigation, by H. P. Malet.

Psyche.—March and April. The Entomological writings of John L. LeConte, compiled by Samuel Henshaw, edited by George Dimmock. Oviposition in Spiders, by J. H. Emerton.

[1] The articles enumerated under this head are usually selected.

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THE EXCURSIONS OF THE GEOLOGICAL SOCIETY OF FRANCE FOR 1878.

BY E. D. COPE.

THE Geological Society of France, though well known in the United States as a publishing body, is not so well known as a school of experts who give practical instruction in their science. In their annual excursions they offer opportunities for acquiring special knowledge in geology of peculiar value. The present season the excursions were arranged in view of the presence of numerous foreigners for a limited time in Paris, so as to exhibit the geology of the country near to, or within easy reach of the capital. There were seven in all, and each one was in charge of a competent geological instructor, while the financial department was under direction of the indefatigable treasurer of the society, Dr. Bioche. A better opportunity of becoming acquainted with the standard of classification of the Tertiary formations which France furnishes to the world, could scarcely have been presented; while the series of beds of the Cretaceous and Upper Jurassic formations visited by the excursionists is, in many respects, very complete. The explanations on the ground furnished by the masters of the subject was all that could be desired for clearness and pains-taking. The leaders of the excursions were Messrs. Hèbert, Lapparent, Tournouer, Vèlain, etc. Among the excursionists we noticed, besides the resident members; M.M. DeWalck, Rutot and Lefevre, of Belgium; M. Stephanescu of Belgrade; M. Renevier, Lausanne; Prof. Guisgardi, Naples; Profs. Almera, Barcelona, and Eulate, Madrid; Fontannes, Lyons; Matheron and Saporta, Provence, and many others.

The first expedition was in the immediate vicinity of the northwest part of Paris, to Vanves, Meudon and Bellvue. At the first

named locality, a beautiful section of the Lower Eocene or Suessonien was examined, which displayed principally the Argile Plastique, below the thin beds of the Lignite of the *Coryphodon*, *Gastornis* and *Palæonyctis*. The whole was crowned by massive beds of the Calcaire Grossier of the Middle Eocene, with its numerous invertebrate fossils. I viewed these exposures with great interest, as the formations contain the remains of a fauna which I rediscovered in New Mexico in 1874. By this discovery I was able to identify the Wasatch horizon of the Rocky mountains with the Suessonien, thus establishing a basis for comparison of formations above and below it, a want not a little felt in North American palæontology. But how different the petrography of the Paris basin from that of North-western New Mexico. Here a thick bed of tenacious lead-colored clay is surmounted by a stratum of more or less impure lignite; in New Mexico heavy beds of hard sandstone alternate with still thicker red and yellow strata of arenaceous marl.

The Calcaire Grossier here yielded its numerous *Echini*, *Cardita planicosta*, *Nautilus*, etc. Further on, along the road towards Meudon, its softer beds formed the banks on either side. Here they were almost composed of two species of *Nummulites*, *N. lævigata* and *N. lamarckii*. Still beyond we visited one of the quarries whence had been obtained many huge blocks of the soft limestone from which so large a part of the city of Paris has been built, and to whose yielding qualities so much of the architectural beauty of the Capital of France is due. Here some of the desolating effects of the German siege were still to be observed. The lowest Suessonien, the Marnes Strontianiferes with their curious mixture of the marine and fresh water shells of the Calcaire Grossier and sands of Rilly, recently discovered, were passed as a white bank on the side of the public way. At Meudon the upper beds of the Cretaceous came in view. The contact of the Pisolitique (Mæstrichtien or Fox hills) with the Marnes Strontianiferes above, was noted as the point of separation between the Tertiary and Cretaceous series. The situation is as though the Wasatch rested immediately on the Fox Hills beds, without the intervention of the great Laramie series; although the Marnes must be regarded as lower in the scale than the lowest Wasatch yet found in North America. A fine exposure of the Chalk, with its characteristic fossils, succeeds the Piso-

litique downwards, and various characteristic fossils were found, including previously unsuspected species of the American genera *Empo* and *Saurodon*.

An agreeable feature of the occasion was a lunch offered by Prof. Chancourtois, member of the society, in his garden at Meudon, which was appreciated as such occasions generally are by hungry geologists.

The excursionists then examined the orange sands and sandstone of the Lower Miocene, at Bellevue, called the Sables de Fontainebleau, well known as the horizon of the *Halitherium*. From this point the quarries of the upper beds ot the Lower Miocene, of the Meulières de Beauce, were visited. This formation, extensively distributed near to Paris, consists of red and yellow clay, filled with large siliceous concretions which contain the casts of great numbers of seeds of *Chara* and small *Lymnaeæ*. At this locality it forms the summit of a hill, from which a magnificent view of the country to the eastward is had. At its foot is the valley of the Seine, abounding in villages, villas and vineyards, and on its opposite side a range of hills bounds the horizon. The most elevated portion of the ridge bears the fort and hospital of Mount Saint Valerien.

The second excursion was to Etampes, Morigny and Jeurres, at a distance of thirty-five miles from Paris. It passed over the Miocene beds above mentioned, and visited some richly fossiliferous localities of the Sables de Fontainebleau.

The third excursion was to Maignelay, at about the same distance from Paris, where the party explored the lignites of the Suessonien, and the lowest bed of that formation, the Sables de Bracheux.

On the 9th of September the excursionists took the rail to Gournay, on the border of Normandy, from which point they passed on foot and by omnibus over a hilly and beautiful country. The region is rich and one of the most beautiful in France. The farmers have left and planted many trees, and the agriculture is of a superior character. Here under the direction of M. Lapparent, the party viewed the outcrops of the Kimmeridge, Portland, Neocomien, Greensand, Gault, and Cenomanien, and collected *Trigonia*, *Gervillia kimmeridgensis*, *Hybodus*, *Terebratula*, with numerous species of *Ostræa*, and *Exogyra*, etc. The dinner

at Gournay at the close of the day was an enjoyable event, and was enlivened with toasts and speeches.

The excursion of the 11th of September was again in the immediate neighborhood of Paris, and had for its object the examination of the famous series of the Gypsum. Passing by rail to one of the suburban stations, the party followed on foot the course of the Seine to the village of La Frette. Here a steep bank, having at a distance much the appearance of a terrace, forms the lower part of the boundary of the river valley, passing behind the village of Sarcouville and extending along the foot of the ridge which here separates the valley of the Seine from a valley immediately to the east of it. The escarpment of this ledge does not exceed twenty feet in height, but it displays a beautiful section of that part of the middle Eocene known as the Sables de Beauchamp. As it offers a good illustration of the manner in which the Tertiaries of the region of Paris are subdivided into thin beds, which represent frequent changes in the character of the water and of the sediment, I give them as explained on the spot by Dr. Vèlain. The lowest bed is a marine sandstone which becomes brackish in its superior part, and contains *Ostrea cucullaris*. Reposing on it is a limestone of lacustrine origin, containing *Lymnæa arenularia;* in a part of the escarpment this bed is wanting. It is succeeded above by a thin bed of scarcely adherent sand, containing *Melania hordacea*, and believed to have been deposited in brackish water. Above this is a stratum of compact marine limestone containing *Cytherea elegans* and *Potamides*. A lacustrine limestone called the Calcaire de Ducy rests on the marine limestone. This bed repeats the second bed of the series in the possession of the *Lymnæa arenularia*, the specimens presenting a slight varietal difference. It is this formation which contains the oldest remains of *Palæotherium*, as I was informed. In the locality described, the soil of the ascending face of the hill conceals higher beds from view, so that it became necessary to pass to other localities in order to study them.

The party accordingly ascended to the crest of the water shed, passing through orchards and vineyards on its slope. The apples were abundant, but not of good quality. On the summit stood a ruined windmill, forming a landmark, and near it a restaurant and cafè commanding a beautiful view of the rich and populous valley on its north-east side, and of the hills beyond. From this

point our route lay again through vineyards and low forest, and along a public highway. Here piles of the meuliéres of the Lower Miocene of Beauce, containing myriads of *Charæ* and *Lymnaeæ*, with the solid bed of the road, testified to the value of this material as a macadamizer. At length we reached the part of the hill which overlooks Sannois, and descending, examined a complete and beautiful exposure of the gypse and other strata of the Upper Eocene. On the most elevated ground we had the Meuliéres de Beauce, and then in the descending order, the Sables de Fontainbleau with *Cytheræa incrassata*, and *Ostrea scitula*. Then a greenish bed of strontianiferous marl, and below it a few feet of clay containing gypsum crystals and fish bones, with *Cyrena convexa*. This stratum terminates the Lower Miocene, resting on a lacustrine bed which is referred to the Eocene. It consists of marl and soft limestone containing *Lymnæa strigosa*, from which shell it takes its name. With it occur the vertebræ of birds and remains of *Xiphodon gracilis*, which belongs especially to this horizon. The *Lymnæa strigosa* marl lies immediately on the gypsum, of which the escarpment at the quarries of Sannois is about one hundred feet in elevation. The material of this celebrated deposit differs from that of Nova Scotia, Virginia and New Mexico, in its waxy color and coarse fracture. Its continuity is interrupted by two beds of white limestone of no great thickness, and at its base is found a heavier bed of marine origin containing *Pholadomya ludensis*. This in turn rests immediately on the "Calcaire de St. Ouen," which is followed in descending order by the Calcaire de Ducy. This was the superior member in the section of La Frette already mentioned, so that with this junction we completed the series of the Upper, and a large part of the Middle Eocene, with much of the Lower Miocene. To connect fully the Middle and Lower Eocene was the work of another excursion, viz: that to Compiégne. From the upper part of the gypsum, at Sannois, I had the gratification of obtaining portions of both jaws, with teeth, and several bones of a *Palæotherium medium*.

Compiégne is a small town at a distance of about a two hours' ride to the north of Paris, on the Northern railway. It is situated on the border of the forest of the same name, and was the favorite autumn residence of Napoleon III. The excursion passed by public conveyance for about two hours through the

forest to Pierrefonds, on the opposite side. This place is a large village, and is celebrated for its immense chateau which stands in the middle of the town. It dates from the fourteenth century, and was restored during the late superintendency of M. Viollet le Duc. From this point the excursion passed on foot, accompanied by the carriages, entirely through the forest in a new direction. The general inferiority of the timber in size and variety, to that to which the American is accustomed at home, was very obvious. It protects several species of deer and numerous wild boars. Wolves are said to be still found there, and I was informed that they had considerably increased in numbers during the late war with Germany.

Between the Calcaire Grossier and the series of the Suessonian or Lignite and Argile Plastique, is an extensive series of sands and sandy marls which are not present in the exposure seen at Vanves during the first excursion. They are called the Sables de Cuise and are referred to the upper part of the Lower Eocene or Suessonian. The present excursion had for its object the examination of this formation. We first found it in banks on the road side, where great numbers of *Cerithia*, *Turritellæ*, etc., lay exposed. Our collectors could hardly leave these for a small quarry off the road, where incredible numbers of these shells, with *Carditæ*, *Solaria*, *Trochi*, *Neritinæ*, *Dentalia*, etc., etc., covered the mounds that stood around or could be sifted from the banks. This is one of the classic localities to which, as to many others visited by these excursions, the palæontologist turns with something like reverence, as the sources of our first knowledge, and hence the standard of comparison for later times and other countries; in fine, as the field of the daily labors of the fathers of palæontology, Lamarck, Deshayes, Cuvier and De Blainville.

Leaving this attractive locality, the excursionists passed to some high banks of sand bordering other roads. This stratum is one of the lower members of the Middle Eocene or Calcaire Grossier in the wide sense. Here we found abundant teeth of sharks, *Oxyrhina*, *Lamna*, *Otodus*, etc., with spines of *Myliobatis*. We soon after took our carriages for the return to Compiégne, which we reached in time for dinner. Our arrival in Paris was late in the evening.

RELIC HUNTING ON THE MOHAWK.

BY S. L. FREY.

IN these latter days there has been a great impetus given to the study of archæology, and many astonishing discoveries have been made by men digging in the dust and rubbish of the past.

We have all been interested in the stories of Schliemann and Di Cesnola, and have looked with much curiosity upon the valuable treasures they have unearthed. Men like John Evans and Boucher de Perthes have, by their study of the implements of the Stone Age, thrown a flood of light upon the pre-historic times of Europe, and the controversy concerning the age of man upon the earth, which now waxes so hot, will doubtless eventuate in approximately determining that question.

The golden wonders of Mycenæ and the bones of Agamemnon, "King of Men," are certainly worth digging for; terra-cottas from Cyprus, and statues from Olympia, and Babylonian tablets take us back into the far past, and rough flints from the caves and gravel beds may lead us to look upon the palæolithic man as a brother.

But while everybody has heard of these strange discoveries in the "far countries," very few know anything about the antiquities of our own country, or of the relics of the Stone Age that lie scattered over the fields all about us.

I have been so much interested myself in the relics left by the old Mohawk Indians, that I trust it may not be without interest to the readers of this magazine if I describe a few of the things picked up, from time to time, upon their old village sites. The relics of all peoples are interesting as illustrating the manner in which they have groped their way up from lower depths of savagism, and valuable for comparison with objects of similar types from other parts of the world.

The similarity that exists among the relics of all Stone Age peoples is a fact that becomes apparent at once to an observer. It is interesting and surprising, and shows that they have all traveled the same hard road, and out of their necessities have wrought out many similar inventions.

The traveler of to-day, as he passes through the beautiful Mohawk valley, has little to remind him of the former savage owners of the soil, who, long before the advent of the Whites,

built their fortified towns on commanding hills, and paddled their elm-bark canoes on the river that bears their name. The insane love of war and conquest that possessed them, their cruelty and ferocity, for long ages made a very pandemonium of the valley that is now so peaceful and prosperous. At the head of the Five Nations, their name indeed "lead all the rest." They kept back the advancing Dutch and English; they were an almost impassable barrier to all French colonizing and proselyting among the cognate tribes in Canada, and red and white together, from Illinois to Acadia, trembled and fled at the cry of "a Mohawk! a Mohawk!"

The Five Nations, or Iroquois, called themselves the Konoshioni, or People of the Long House. The Mohawk valley was the eastern door, and the Mohawk tribe held it. While much has been written, from the time of DeWitt Clinton to the present, about the antiquities of the other tribes of the Confederacy, very little has been said or is known about the relics of the Mohawks. All that are described and illustrated in this article have been found on what are presumably sites of old Mohawk villages. These sites naturally divide themselves into two classes; the first, those unmistakably occupied during the Stone Age proper, where are found only relics of stone, and clay, and bone; and second, sites where relics of a mixed character appear, consisting of similar relics to those of the first period in connection with articles introduced by the whites after the discovery.

Village sites that can be certainly identified as belonging to the time previous to the introduction of metals are few; a diligent and careful search may discover more than are now known, but at present I know of but two. The first of these was evidently a place where the rough material was quarried and stone implements manufactured, as there are innumerable flakes and flint chips, broken and unfinished weapons and tools, and many arrow heads, etc., scattered over a surface of several hundred acres in extent. The other site is one of peculiar interest; as it has never been cultivated, and is covered with a pine forest, everything is undisturbed and is just as it was when it was deserted by the savages. It is a very Kjökken-Mödding, where heaps of the refuse lie untouched. Here in piles of ashes and clam shells are found innumerable fragments of pottery, broken bones of animals, stone and bone implements, deers' horns, bears' and beavers'

teeth, and many other evidences of savage life. It is upon a point of land where two ravines meet, was evidently palisaded, and must have been an impregnable fortress when the only weapons were bows and arrows.

The labor that was required to surround such an extensive village must have been immense, especially when we remember that only axes of stone were used, similar to Fig. 1. These "celts" or hand axes are found the world over; this one is of a compact hard kind of green stone, has a fine cutting edge and is polished over its entire surface. These axes are called "thunderbolts" by the common people of many widely separated nations. Mr. John Evans, in his great work on the "Ancient Stone Implements of Great Britain," gives much interesting and curious lore in regard to this and similar superstitions. I have heard the same name applied to these ancient tools here in the Mohawk valley. Very poor tools we should call them, but in the hands of a savage proved wonderfully effective for cutting down trees and hollowing out canoes when used in connection with fire.

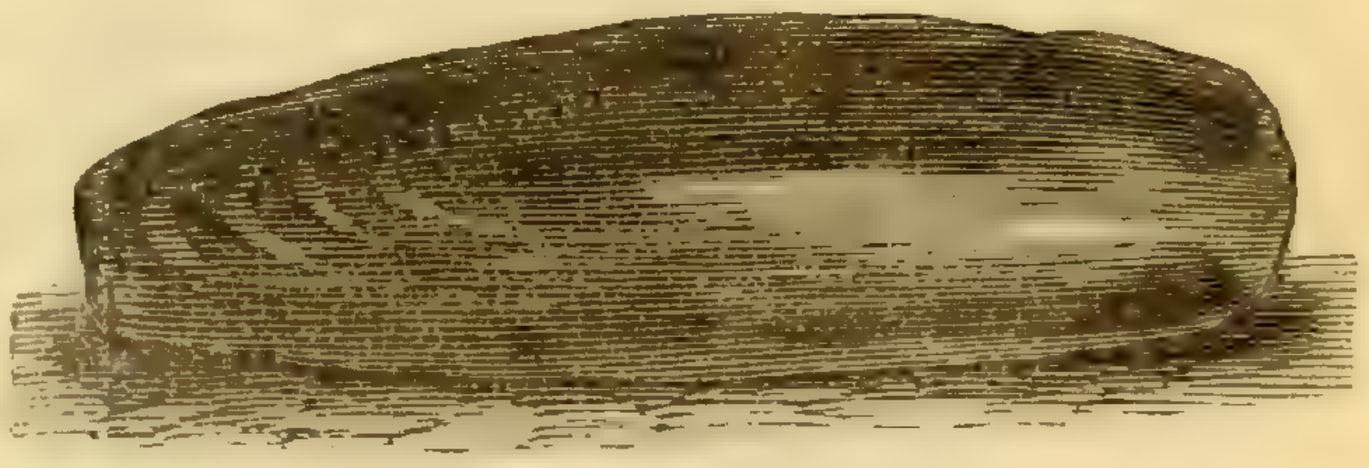

FIG. 1.—Celt.

In Fig. 2 is presented a side and front view of a stone carving carefully and skillfully cut out of a hard black stone; it seems to have been worn as an ornament or a charm, grooves being cut round it; as a specimen of the carving of a people having no iron tools it is certainly remarkable. The Mohawks were divided into three clans, the turtle, the wolf and the bear, and possibly the Indian who owned this may have been of the bear genus, and this may have been his "totem."

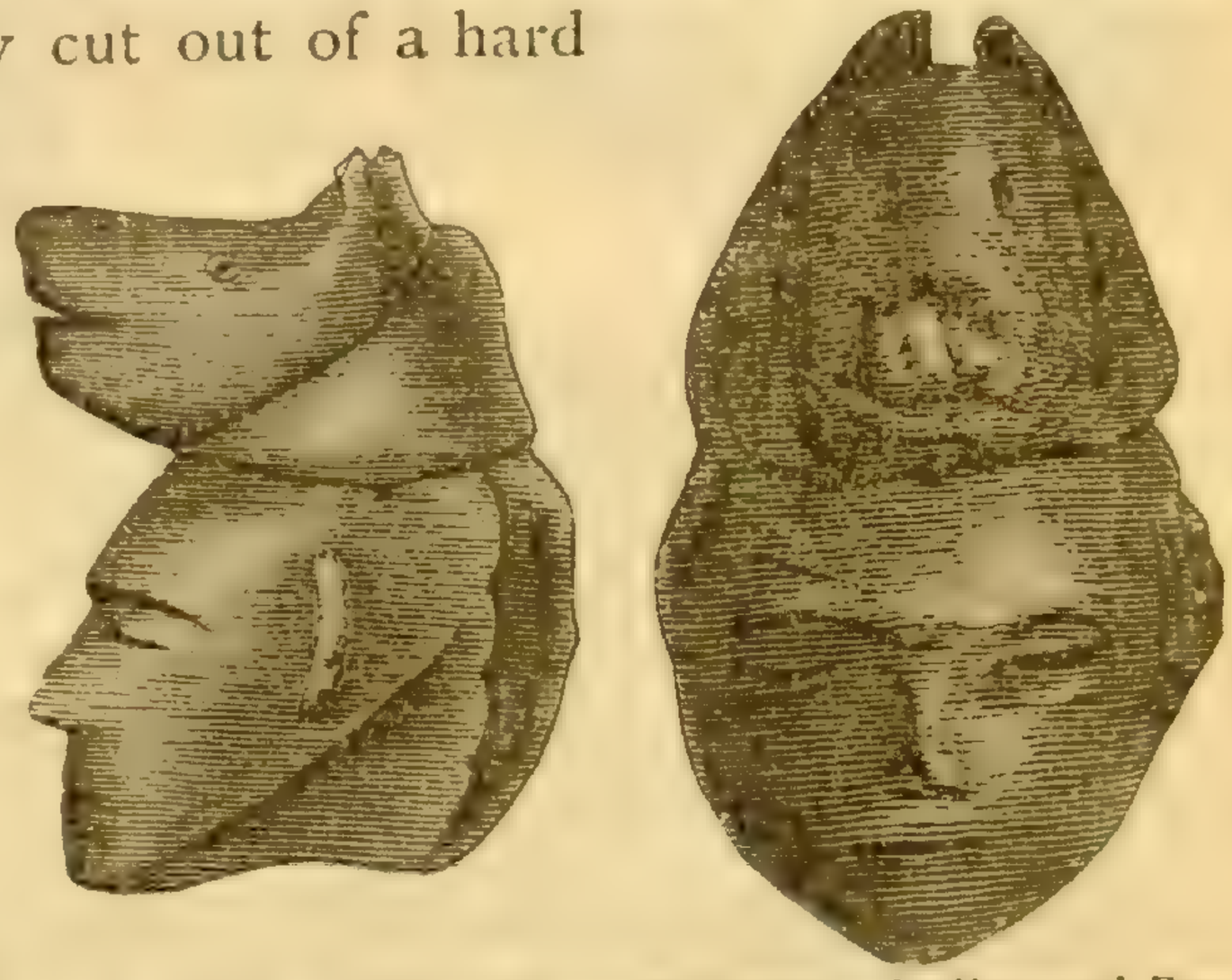

FIG. 2.—Side and front view of Totem—Indian and Bear. (full size.)

Upon the site previously referred to, fragments of pottery similar to Figs. 3 to 7 are found. It is unglazed and very hard, and seems to be made of clay and pounded shell or stone. The jars were of all sizes, round on the bottom, but made with a rim so that they could be suspended with a cord or strip of bark. The decoration consists of an exceedingly diverse arrangement of incised lines and dots, and it would appear from the

FIG. 3.—Mohawk Jar.

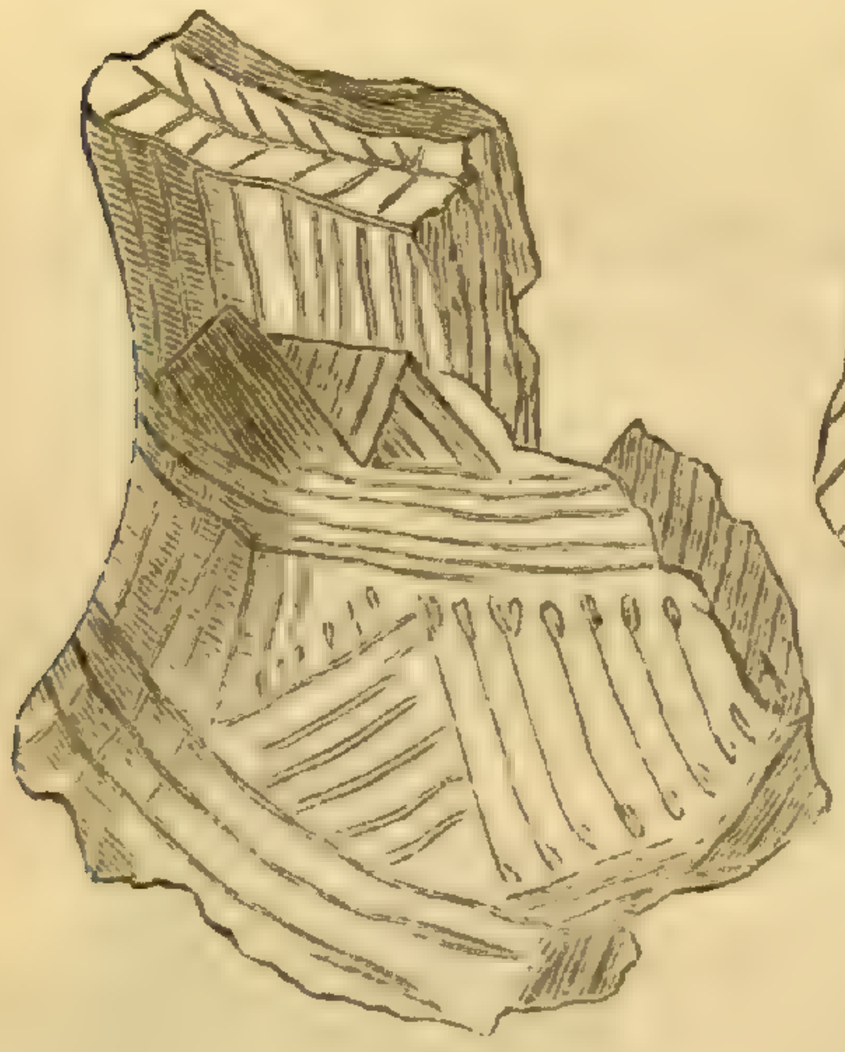

FIG. 4.

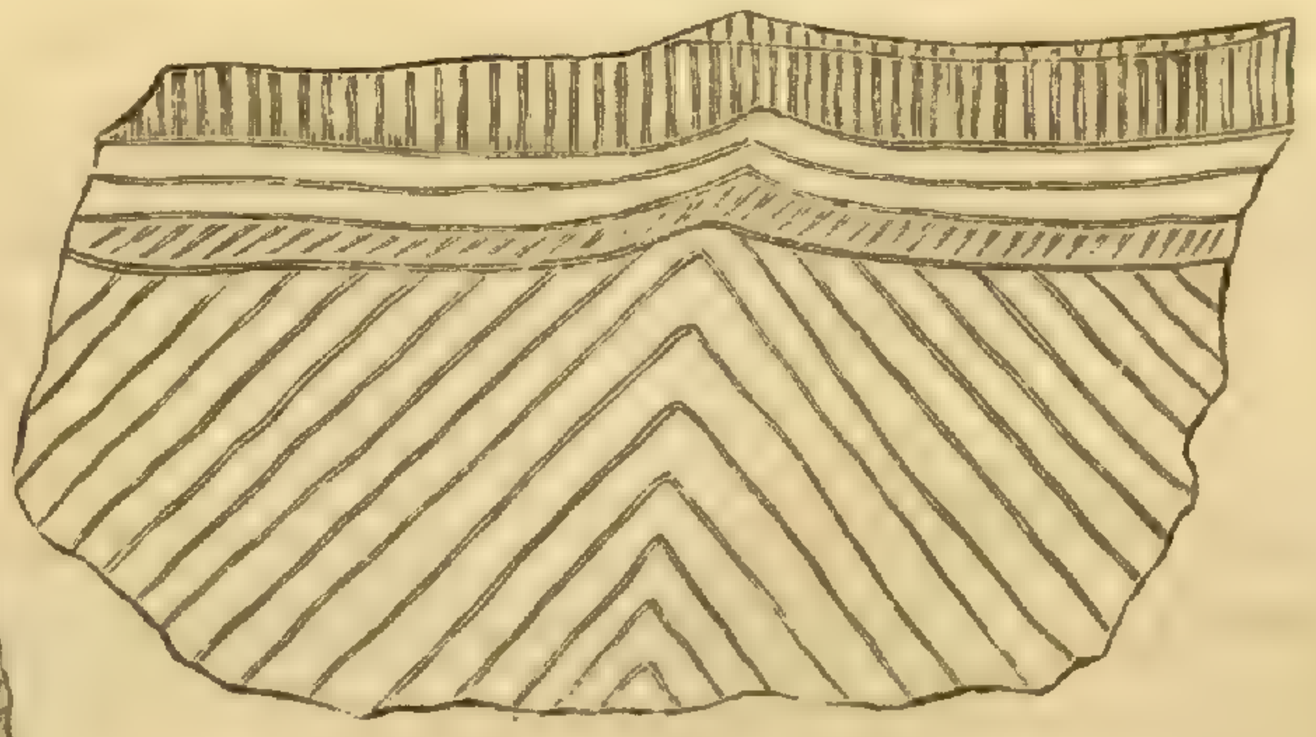

FIG. 5.

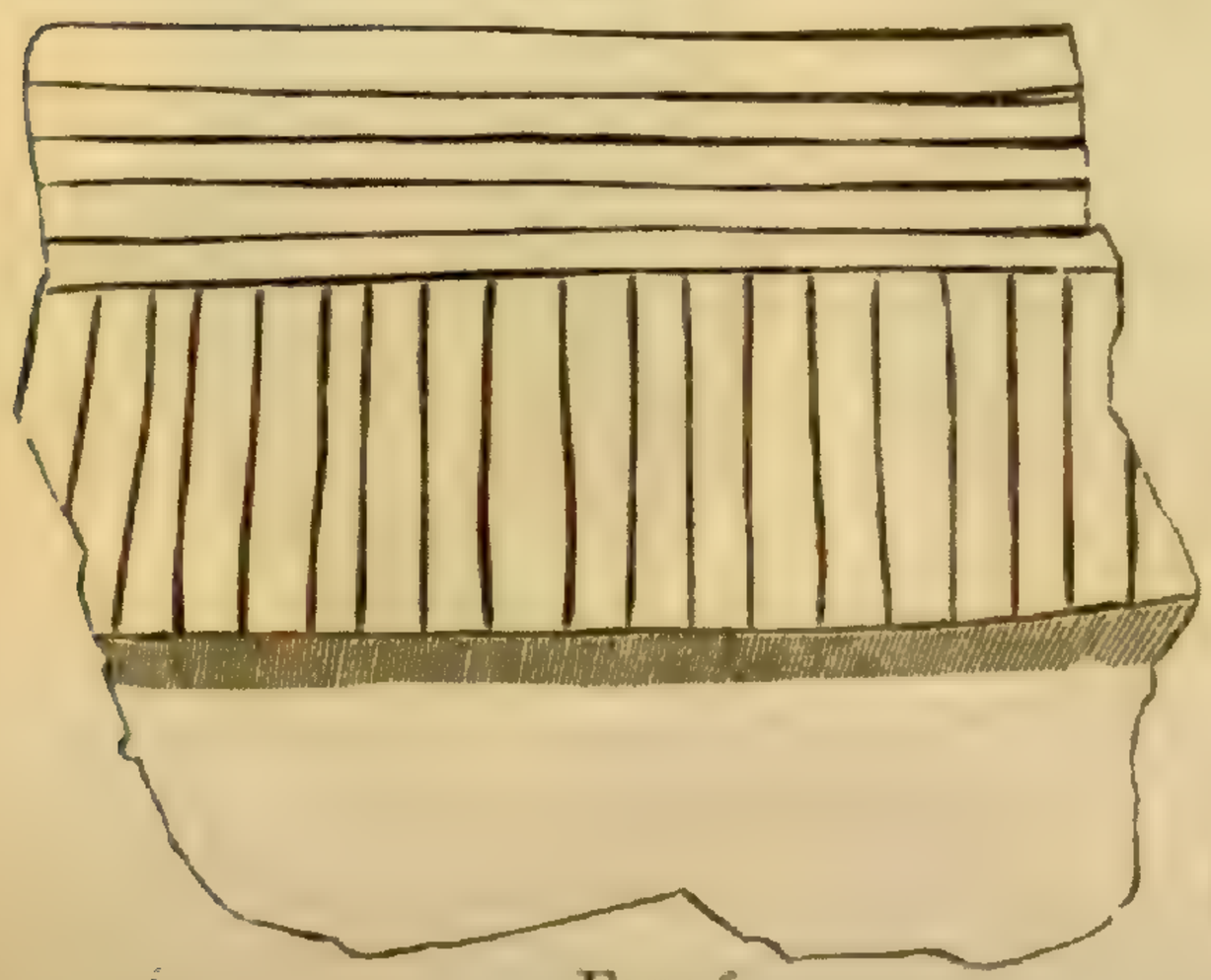

FIG. 6.

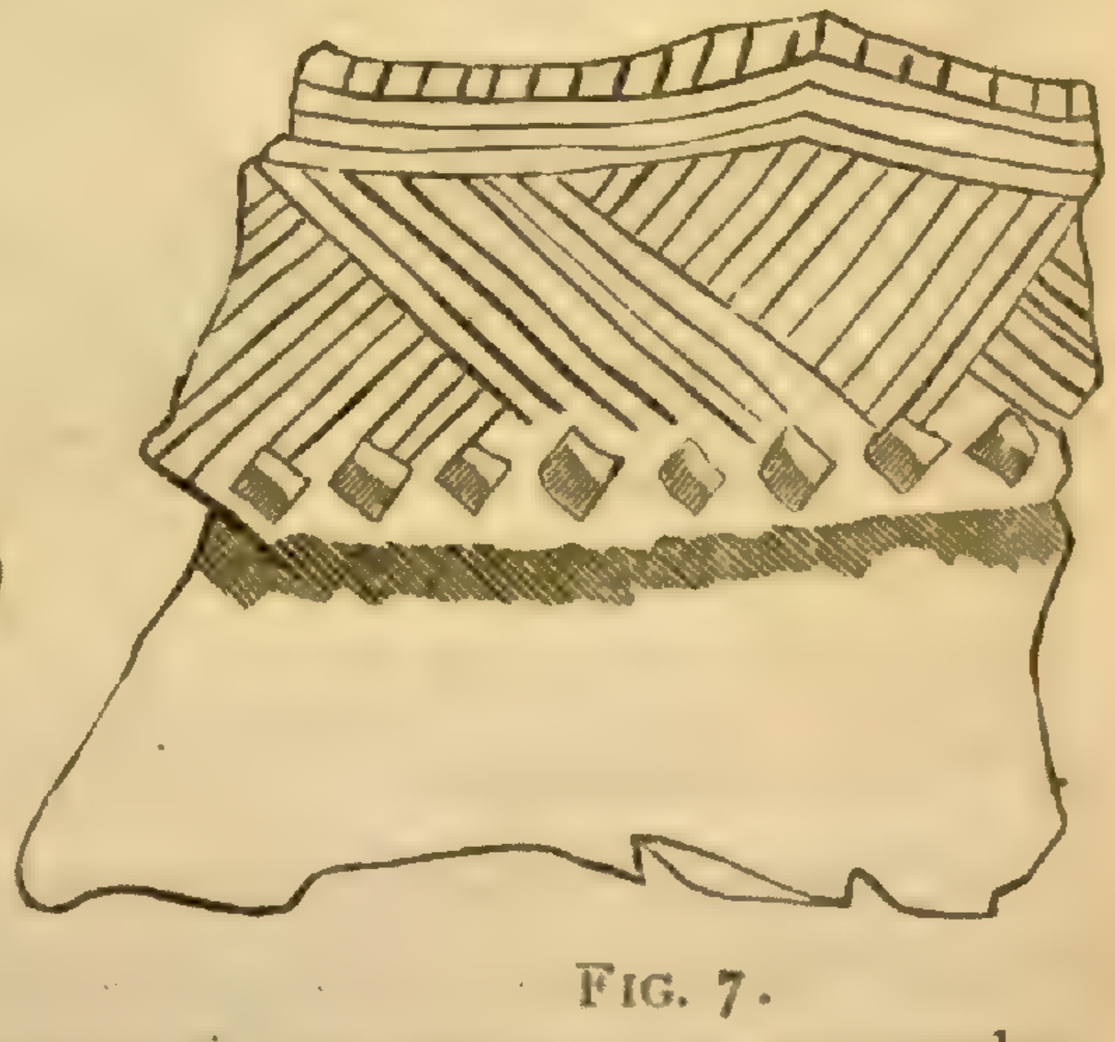

FIG. 7.

similarity of the shape and ornamentation that there were regular

potters who manufactured all that were used by the village, and they seem to have had considerable skill in the plastic art, for not only is the pottery very creditable, but they also worked clay into other forms, showing great ingenuity in makings pipes, the bowls of which are frequently in the form of a bird or mammal, and these always being very true to nature. Some of these are shown in the engravings which fail, however, to give the spirit of the

FIG. 8.—Fragment of Pottery Pipe.

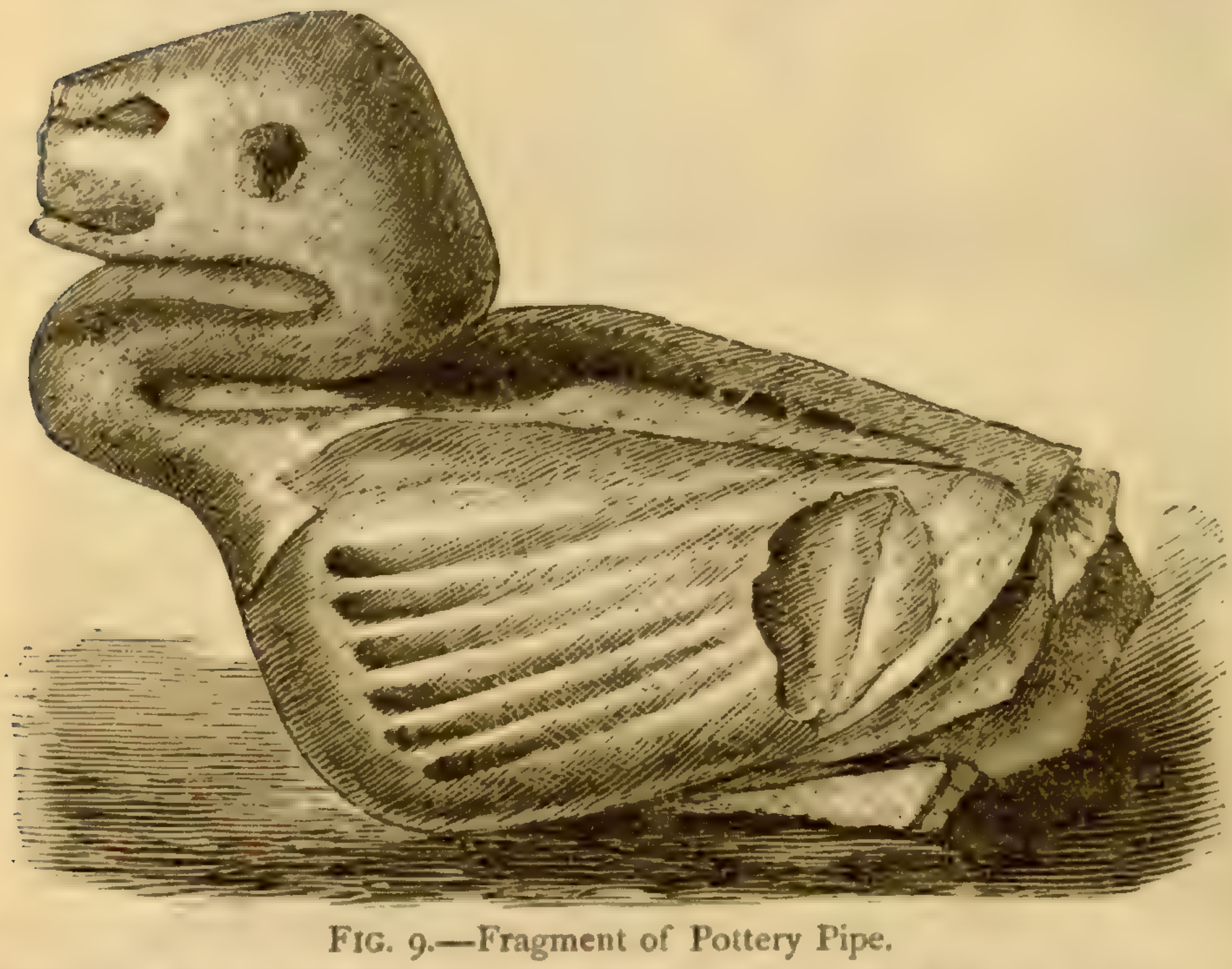

FIG. 9.—Fragment of Pottery Pipe.

originals. Fig. 9 is the fragment of a pipe and Fig. 10 and 11 are

samples of birds and animals, rude in style to be sure, but by no means inferior to similar terra-cottas from Mycenæ and Cyprus.

Among Aboriginal relics, bone implements are much more rare than those of stone, for

FIG. 10.—Owl.

FIG. 11.—Fox.

when exposed to the weather they are soon destroyed, and the sites of villages that are uncleared and uncultivated, and where these bone tools alone are found, are very few. Those that are found here, of which Figs. 14, 15 and 16 are samples, are for the most part awls or piercing implements, and are well made and highly polished; they have been worked out of hard compact bones, and scraped down with great labor. Among the many broken bones that are found, are some which show the grooves made by the stone saws in cutting out these tools.

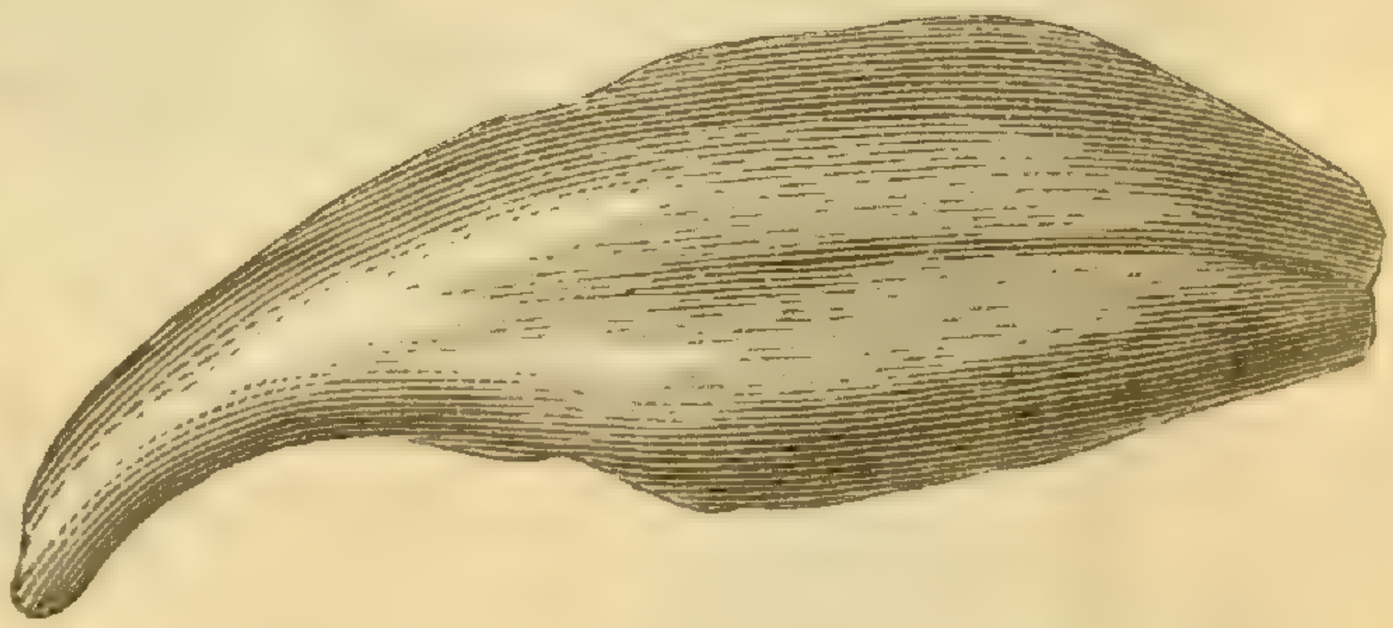

FIG. 12.—Bear's Tooth.

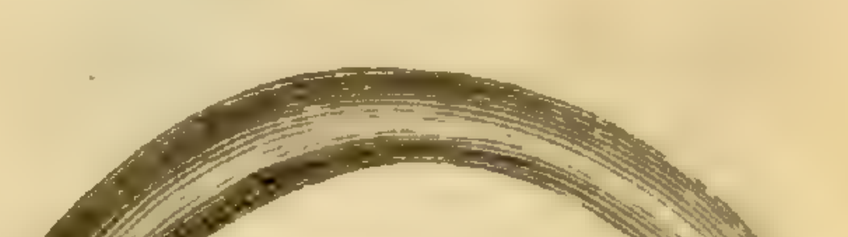

FIG. 13—Beaver's Tooth.

FIG. 14.

FIG. 15.

The bones of animals, like those in similar situations in other countries, are all split and broken to extract the marrow, and the teeth and jaws of bears, and deer, and beaver are as well preserved as though buried yesterday. Many necklace bones like Fig. 17, are found which show a great deal of laborious scraping.

FIG. 17.—Necklace bone.

FIG. 20.

FIG. 16.

FIG. 18.

FIG. 19.

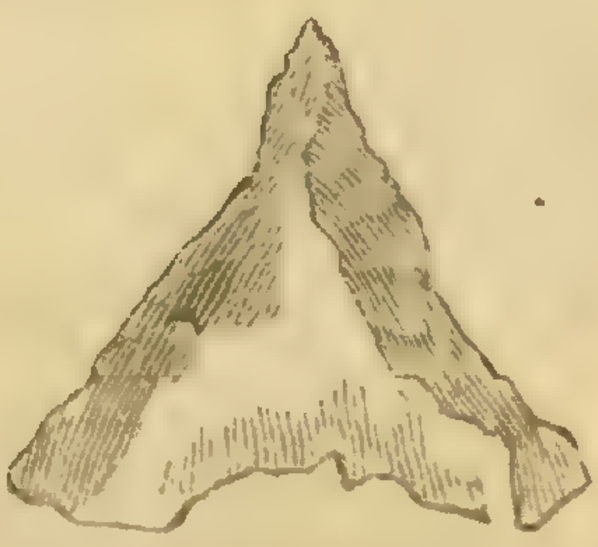

FIG. 24.

Necklaces of this kind were made by some of the tribes of the finger bones of their enemies, the squaws usually commencing the torture of a prisoner by sawing off the forefingers with a clam shell.

Upon all the village sites, upon the surface of the fields, and in the graves, the usual forms of stone implements are found, those

that are rough and chipped predominating largely over those that are ground and polished. Indeed one is greatly impressed with the remarkable similarity that exists between these rough stone implements and the palæolithic flints from the caves and gravel beds of Europe, and it would seem to be no difficult task to duplicate in a great measure from the surface finds, the engravings of these implements as given in the European archæological works on the subject. Many of those found here resemble the cave and gravel implements much more closely than any shown in this article.

Arrow heads are of many forms, and are made of various kinds

FIG. 21.

FIG. 23.

FIG. 25.

FIG. 27.

FIG. 22.

FIG. 26.—Hammer Stone.

of hornstone, and slate, and spar. Some of them are exceedingly rough, while others are flaked with great skill and are beautiful specimens of workmanship. All the forms of flint

implements such as knives, scrapers, borers, drills and others of unknown or not obvious uses, are abundant. Figs. 28 to 30 show a few of these latter forms.

The foregoing are specimens of what the Mohawks used during their Stone Age, but relics are abundant that were brought in at a very early day by the whites. Such are beads of various kinds, pipes and nondescript fragments of cop-

FIG. 28.

FIG. 30.

FIG. 29.

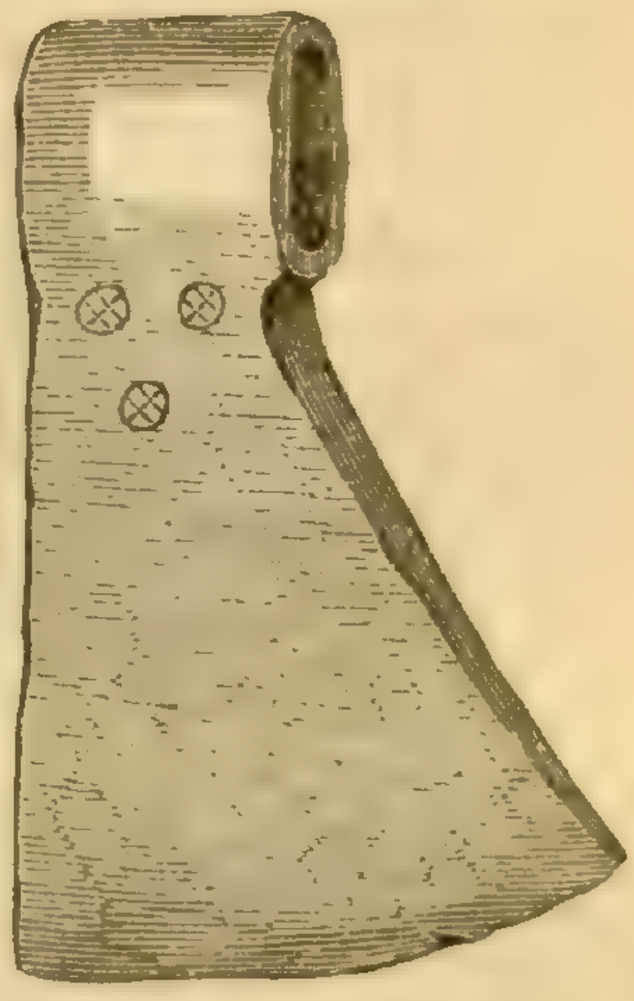

FIG. 31.—Trade Axe.

per, iron and lead, notable among which are the axes, Fig. 31, which although rude and clumsy in the extreme, were yet a great acquisition to men who had for generations, with infinite labor, wrought axes out of the flinty rock. These trade axes probably began to supersede those of stone previous to the year 1600, for Champlain in his expedition against the Mohawks in 1609 speaks of them as cutting down trees "with villainous axes of stone, and also of iron, which latter they had captured from their enemies;" their enemies were either the Indians of Canada, who obtained iron from the French as early as 1535, or of those southern tribes with whom the Mohawks were always at war.

In conclusion, I feel how impossible it is to do justice to this subject in so small a space. The extent of it can be imagined from the fact that the few forms here shown are from a collection of several thousand specimens. It is sufficient, however, to throw some light upon the manner of life and the progress of a people who filled so conspicuous a place in history at a time when European nations were struggling to gain a foothold in this western wilderness.

WALKS ROUND SAN FRANCISCO.

BY W. N. LOCKINGTON.

No. III—LAKE HONDA AND SEAL ROCK.

Ancylus fragilis, the so-called fresh-water limpet, is on record in Cooper's list of the Californian mollusca from Laguna Honda, or Deep Lake, as the name, being translated, implies.

Now Laguna Honda, a pond at the bottom of a deep valley about three miles south of the Golden Gate, has been captured by the Spring Valley Water Co., and converted, by upright retaining walls, and dams, and flood-gates, into a reservoir some thirty feet deep.

It is therefore pretty clear that the Ancyli in Laguna Honda are not easy to collect, but with the object of searching for the species in a lower lake which receives its overflow, my son and I start off for the locality one windy summer morning. Our road from the cars lies across Golden Gate park, the public park of San Francisco, a long narrow strip of land commencing some distance from the city and running straight out westward to the ocean beach. The greater portion is as yet park by courtesy, as the strip of land is principally drifting sand. A small portion at the city end is laid out, and drives are made through the whole length, but nineteen-twentieths of the area either lies at the west wind's will, or is covered with a growth of the large yellow lupine (*Lupinus arboreus*) and the blue wooly-leaved lupine (*L. chamissonis vel albifrons*). As the city has chosen a site without soil for its park, it is bound to try to make its own soil, and these lupines, hardy natives of the sand, have been selected as aids in the work. They prove very efficient, but the annual appropriation for park expenses is so small, and the west wind so constant, that he would be a bold man who would prophesy that the lupines shall be victorious for a generation or two. Between the park and the valley where lies Laguna Honda, is a high hill called Sweeney's Peak, from whose summit is obtained an extensive view over the peninsula and the bay.

There is little to detain us in the ravine by which we ascend, as the season is too advanced for many flowers, but the snow-ball bush (*Symphoricarpus racemosus*) displays its white bunches of fruit in the hollows, the red-flowered *Allium acuminatum* grows

on the hill-side, and the little song-sparrows flit before us from stone to stone as we advance upwards.

While standing on a spur near the summit, gazing on the panorama of the city and its surroundings, my son, who is bent on exploring, suddenly shouts from behind a large rock, " Papa, here's a fern!" And sure enough, in that dried out spot, in the crevices of a rock five hundred feet above the sea, far from all moisture, grow numerous examples of a thick-leaved simply pinnate fern. We secure some of the plants, and on enquiring from our botanical friends, find that the curious fern is known as *Polypodium scouleri.*

It is a rough descent over the sun-baked soil and slippery bents of grass from Sweeney's Peak to the Laguna, which nestles in the deep valley between it and the opposite peak.

Castilleia parviflora and *Convolvulus occidentalis* are almost the only flowers we find on our way down, and as the water in the lake is too low and too free from vegetation to give us a chance to collect Ancylus, we direct our course along the flume to the lower lake, passing through a dense thicket of *Silybum marianum*, or blessed thistle, a plant which, since its probable introduction by the Spaniards, has increased to the dimensions of a nuisance.

At last, on the stems of *Sium latifolium* we find a few Ancyli, tiny little vesicles of shells, which would certainly be overlooked by any one not specially searching for them, since they are only about a third of an inch long, almost colorless, applied to the stem by the whole of their under surface, and very much flatter above than their namesakes of the ocean beach. These " fresh-water limpets," it may be as well to remark, are but distant relatives of the real limpets, they are " Pulmonata, "or air breathers, like the fresh-water snails and the land snails, while the limpets are provided with gills like other univalves of the ocean. This is one of those cases, so many of which occur in the animal kingdom, where considerable outward resemblance masks radical structural differences.

As this is a rambling paper, and the last that we shall piece together from our rambles on this wind-stricken peninsula, we will lengthen out our walk northwards until we reach the Seal Rock road, along or near which we will trudge till we descend to the ocean beach close to the extensively-advertised Seal Rock. Seal Rock is one of the greatest lions of San Francisco, or

rather, it is the home of San Francisco's lions, those sleek and well-fed sea lions, which are protected from slaughter by special legislation, that they may, in conjunction with wasteful human fishers, destroy the "harvest of the waters." The rock is within easy rifle-shot of the terrace of the Cliff House hotel, yet it is crowded with sea-lions taking their ease in all kinds of positions, evidently fully aware that they will not be harmed. Most of the colony are dozing in the sun, occasionally opening their eyes, raising their heads, and perhaps uttering their characteristic howl; but some more active, are swimming among the breakers, their heads alone visible above the water. "I cannot understand how those things can bear such a life," remarked a well-dressed woman near me, with a look of disgust. And this when the creatures were basking in the sun and playing in the water with the most evident enjoyment—perhaps they were thinking the same of us—who can tell?

The long stretch of sandy beach between Seal Rock and the Ocean House does not present us with many forms of marine life that do not also occur in the Bay of San Francisco. *Cardium corbis* and *Macoma nasuta* are common, and so is the pretty little light-reddish bivalve *Mæra salmonea*. At intervals you may pick up the test of a very thin and flat cake-urchin, *Echinarachnius excentricus* A. Ag., looking like a large wafer; its height from crown to mouth so small that you almost wonder where the creature lived, and how it could ever move its heavy covering.

On the sand banks that form the bar at the entrance of the harbor, at a depth of six or seven fathoms, this sea-urchin can be procured alive; its test is then covered with a thick array of small spines, so closely set that when the creature retracts its suckers it is difficult to make out the "petals" or curved outlines of the ambulacral pores through which the suckers protruded. The name "*excentricus*" is very appropriate. The system of calcareous plates forming the crown (apical system) and containing the genital and ocular plates with their pores, is not in the centre as it is in the allied *E. mirabilis*, but is approximated to the anterior extremity of the test; neither is the mouth in the center of the underside. Two other species of sea-urchins, or Echini, glorying in the names of *Strongylocentrotus franciscanus* and *S. purpuratus* occur along the ocean beach at points not very far distant from San Francisco, but are not found in its immediate

neighborhood. The first of these attains a large size, the test or shell, denuded of its long spines, measuring five inches or more in diameter; the second has short spines, and is about two inches across. These are "regular sea-urchins," that is to say, they belong to that sub-order of the Echini which has circular, high, sometimes almost globular tests, with the five ambulacral areas at equal distances and of equal dimensions, pierced with rows of pores continuous from the mouth below to the apical system above, which latter contains not only the "ocular" and "genital" plates, but also the posterior termination of the digestive canal. The cake-urchin before mentioned, like all its near relatives, has the anus on the under side, thus departing farther from the "radiate" type, and the rows of ambulacral pores for the exit of the suckers are confined to the upper side of the test.

Along the upper portion of the sandy beach, at points where there are no cliffs but where the land meets the sea in rolling ridges of sand, may be found several plants which do not occur in other situations. Among these are *Frinseria chamissonis* and *F. bipinnatifida*, two compositæ with inconspicuous flowers and hispid fruits, covering large areas with their trailing stems and glaucous foliage; *Abronia cycloptera*, a relative of the garden flower commonly called four-o'clock, with its upright bunches of sweet-scented reddish flowers; *Heliotropium curassavicum*, one of the *Boraginaceæ*, with curled-up spikes of small white flowers, and thick leaves, and the yellow-flowered *Ænothera cheiranthifolia*.

On the cliffs near by, *Sedum spathulifolium* makes a show with its bunches of yellow flowers, mingled, perhaps, where the soil is deeper, with *Aster chamissonis* and the golden-rod, *Solidago californicum*. Here is a large area of cliff face covered with the long trailing stems of *Mesembryanthemum dimidiatum*, the three sided oblong leaves glistening in the sun, and the large deep-purple flowers glowing at intervals like rubies. It is the monarch of the sea-side flowers, and is worthy of a place in the flower-garden, but must not be planted in too rich soil, or it will run to stems and leaves, and forget to bloom.

On the hill-sides the most conspicuous plant is the "bladder-weed," *Astragalus menziesii*, not in bloom now save a few belated blossoms, but hung all over with the bladder-like pods from which its vernacular title is derived. The seeds in the ripe pods

rattle in the wind and the name of "rattle-weed" has thus arisen. A third name is the Spanish title of "loco" or "mad" plant, from the effects of its poisonous foliage upon the hungry cattle which are occasionally tempted by its green foliage and succulent stems—green and succulent when all around is brown and scorched, when even the "burrs" of the burr-clover (*Medicago denticulata*) are scarce and baked to chips, and the bents of grass are broken down into chaff—to feast upon what in times of greater plenty they avoid.

Although, broadly speaking, there are no trees on the peninsula of San Francisco, except the thickets of scrub oak (*Quercus agrifolia*) which clothe some of the more sheltered hills and valleys, yet the ravines of the few permanent springs display a crop of willows, mingled with a few examples of *Myrica californica*; and cliffs with a northern aspect are in some spots made beautiful by an abundant growth of *Heteromeles arbutifolia*, a showy rosaceous shrub, with red berries like the European hawthorn, but no thorns. Earlier in the season it blooms into a mass of showy bunches.

Ceanothus thyrsiflorus, a few starvling plants of which may be found among or near the willows, is, in more favored localities, one of the loveliest of shrubs, or rather trees, for it grows to the size of an apple tree. Covered all over with lilac-like bunches of odoriferous blue flowers (whence its local name of "blue myrtle"), and growing in extensive thickets over terraces and uplands, it is a living contradiction of the theories of color purists who deny that blue flowers and green leaves can be beautiful.

If we pick our way through the sand and over the hard-baked bed of what in winter is a watercourse, to one of the little coves which lie between the cliffs, we shall probably find numerous specimens of the curious little crustacean, *Hippa analoga* Stimpson. This little fellow lives in the sand between tide-marks, and although in the vernacular confounded with the species of *Orchestia* and *Allorchestes*, under the general term of "sand hopper," really belongs to a very different and higher division of the class Crustacea than that which includes his companions of the sand. He, or rather she, for the female is much the larger, has the body longer than wide, a narrow abdomen tucked under the body like that of an ordinary crab, five pairs of limbs, eyes

borne on stalks, and very conspicuous antennæ and mouth appendages. Thus he belongs to the *Decapoda* or ten-footed crustacea, while the other sand-hoppers, with seven pairs of limbs and sessile eyes, are in a lower sub-class. His great forte appears to be digging in the sand, which he does backwards, and with astonishing rapidity, disappearing in an attitude similar to that of a diving duck. Securing a few of these lively fellows, we return up the watercourse and across the sandy prairie to the road, gathering, as we proceed, a few flowering stalks of the yellow *Bahia lanata* and a twig of *Croton procumbens*, with its light green berries.

I think it is about time that the notion that a species must necessarily be named after some peculiarity that it possesses, should pass into the limbo of exploded ideas. There are now so many species of animals known, that it is, in many cases, impossible to define the differences between those which are nearly related in one word—it needs at least five lines of writing to do it. Two species differing in twenty particulars, no one of them, perhaps, very important, cannot be correctly distinguished by incorporating one of these points of difference in a specific name, and it frequently happens that a name which correctly describes one species will apply equally well to another species which has other peculiarities rendering it totally different. Thus *Sebastes ruber*, the red rock cod, is red enough, but there are two or three other red species of the same genus in our waters; and among the shrimps of the genus *Hippolyte*, *H. brevirostris*, although it has a short rostrum, is excelled in that particular by other species. As species are distinguished from each other not by one but by several peculiarities, it sometimes happens that the very character which, from its conspicuousness, has been incorporated into the specific name, may be wanting in an individual which yet belongs to the species; thus *Asterias ochracea*, the ochreous star-fish (our common species), is quite as frequently deep purple as yellow, and *Astacus nigrescens*, the blackish cray-fish, is usually of quite a light tint.

The great necessity of zoölogical and botanical nomenclature is not so much to have a descriptive name for every species as to have one fixed, indisputable name by which each shall be universally known. This is an end difficult to reach, but will, at least in the majority of cases, be at length attained. Isolated workers in different countries, or distant parts of the same country, not

having access to the results of each other's labors, have separately described the same species, and have each given it a name. Perhaps one has called it *obesus* because it was short and thick, another, *sanguineus* because it was red, a third, *macrodactylus* because it had a large toe, while a fourth has named it *smithii* after his friend, John Smith.

But it is now a recognized rule among naturalists, and it is a rule that ought to be rigidly enforced, that priority of publication shall give precedence, and as soon as it can be ascertained which of the names was first given, provided it was accompanied by a description, that name shall in future be the name, no matter whether it is good or bad Latin, or even whether it is rightly or wrongly spelled. It is the baptismal name, and, like that of an infant, must ever remain its name. It is only by keeping to this rule that we can ever reach bottom in scientific nomenclature; if every aggressive genius were allowed to change a well-known name for one that, in his estimation, fits it better, and if every Latinist, ignoring every consideration but those belonging to his pet grammar, might alter terminations and orthography at his will, the synonymy of species would be endless. The same rules apply to specific names that apply to the surnames or cognomens of human beings.

When men were fewer, and proper names like John and William were the only recognized ones, the various Johns and Williams were distinguished from each other as John the baker, John the butcher, etc., or personal peculiarities were made a note of, and William Tallboy and John Short, with other sometimes very curious names arose; or a man leaving his native town of, let us say, Lincoln, became known in his new residence as John of Lincoln. These names stuck to the families, the members of which changing their trades, or possessing different physical peculiarities, often become the antipodes of their names. Thus, John Baker may be an iron monger, John Short may be tall, William Armstrong may be no stronger in the arm than John Smith, and John Gross may be a Lilliputian. I must now beg pardon of our esteemed corresponding secretary of the California Academy of Sciences, because I have taken the liberty to append his name to a species of fish which I believe has hitherto not been described. Many other names would fit it; it is long, slender and round, so are all the tribe it belongs to; it is brown, so

are others that are nearly related; it has two rows of teeth on each side of the mouth, so have all its family; there are ten teeth in the front row and nine in the back; this is characteristic, but it would puzzle the best Latinist to put it in one word; and it has eleven gill openings, and this might be expressed by a compound Latin name which would be awkwardly long, and after all would not mean with eleven gill openings, but simply with eleven openings, so that on the whole I prefer *stoutii;* and stoutii, with the doctor's permission, it must be, unless some one has anticipated me in describing the fish.

Bdellostoma stoutii nov. sp. Eleven gill openings on each side; ten teeth in the anterior and nine in the posterior series. 15½″ long. Eel river, Humboldt county.

It is rather singular that this fish, which is abundant in Eel river, and is sold for food, and also occurs in this harbor, should hitherto have escaped notice. I believe it to be the only species of its genus hitherto found on the Pacific coast of North America; and it differs from *Bdellostoma polytrema*, a species which occurs along the coast of Chili, both in the number of its gill-openings and that of the teeth, *B. polytrema* having fourteen of the former and twelve of the latter in each series.

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THE BENEFICIAL INFLUENCE OF PLANTS.

BY J. M. ANDERS, M.D., PH.D.

A GOOD deal of attention has recently been given to the subject of the sanitary relations of plant life. Since plants constitute so great a factor in the organic world, a study of their functions necessarily becomes interesting and important. As every one knows, the knowledge of these processes is being rapidly unfolded, and clearly, the way to render this most useful is to examine into their practical relations; for our appreciation of plants and flowers must, to a great extent, go hand in hand with the increase in knowledge concerning their influence on our health and welfare. As our information in this direction increases we shall be more ready to acknowledge how much we owe to vegetation; still it is to be hoped that our ideas will never revert to the extravagant theories of the ancients, for we find that mythology credits trees with marvelous powers, such as their

being the abode of spirits, some of which were held sacred while others were supposed to be demonic. Trees were also supposed to be sentient beings and even possessed of souls. Strange as it may seem in this age of enlightenment, some relics of these ancient superstitions still linger in certain quarters of the globe.

Prof. Pettenkofer[1] has lately discussed the question of the hygienic relations of plants from a new standpoint, and has doubtless thrown new light upon it. He has, to his own satisfaction, demonstrated that three of the great functions in plants, namely, the giving off of oxygen, the absorption of carbonic acid and generation of ozone, really have no hygienic value whatever. The proof of his argument rests largely upon the solid basis of experimental researches conducted by himself and other noted investigators. It is but fair to say, however, that Prof. Pettenkofer does not deny *all* hygienic influence of vegetation, but attributes its influence to other circumstances rather than to the variation in the amount of the gases; and yet, in setting forth what he believes to be the sanitary operations of plants, he omits making any allusion to the process of transpiration as affecting the sanitary conditions of the air. This is not so surprising when we reflect how very imperfect our knowledge of this function has been up to a very recent date. In a paper on this subject we have presumed to attach more importance to this function.

We shall now make the proposition—a deduction from actual experiment—that the hygienic conditions of the air are both directly and indirectly affected by plant transpiration. It will be seen that the statement ventured contains two distinct elements, one implying the direct effect of transpiration on the air, the other the indirect; and it has been deemed best to discuss these elements separately in order to render the subject easier of comprehension.

The direct effect of transpiration might be formulated thus: In all atmospheres in which the proportion of aqueous vapor is less than the healthiest standard (about seven-eighths of what the air can contain at a given temperature), the beneficial influence of transpiration must be in proportion to the amount of aqueous vapor exhaled. In this connection the question naturally arises, What is the rate at which watery vapor is given off from plants? Here it will, perhaps, be pardonable to refer to the author's pre-

[1] Popular Science Monthly for February, 1878.

viously published experiments[1]; and, in order to establish this rate an extract from the summary of these investigations will be introduced, since they were instituted with the object of establishing the rate of transpiration:

In clear weather the evaporation by night, as compared to that which takes place in the day, appears to be about in the ratio of one to five. In some cases no loss occurred on dewy or cloudy nights. The camellia, however, lost nothing during clear nights, and gained in weight on dewy or rainy nights, even when kept indoors. Under ordinary circumstances evaporation at night was about the same indoors as in the open air.

The rate of transpiration during the day showed a very different relation, giving a ratio of two to one in favor of the open air. Of the whole amount evaporated during twelve hours, in the day experiments, half was given off between the hours of 11 A. M. and 3 P. M., as shown by repeated testing.

The following table, compiled for the number of clear days, will serve to exhibit the average rate of transpiration by day which took place in the open air during clear weather. It will also indicate the relation between leaf surface and the weight of the plant, and amount transpired. The mean temperature and average dew point have also been recorded in the table:

No.	Name of Plant.	Duration of Experiment	Average Evaporation.	Evaporating Surface.	Weight of Plant.	Average Temp.	Aver'e dew pt
1	Calla	12 hours	2850 grains	All parts green	2 lbs. 2 oz.	. . .	. . .
2	Geranium	"	3500 "	. . . . .	44201 grains	. . .	. . .
3	Fuchsia	"	1975 "	450 square in's	1920 "	64.5°	49.6°
4	Hydrangea	"	2858 "	744 "	2170 "	73	56.7
5	Camellia	"	710 "	479 "	. . . . .	75.5	63.3
6	Lantana	"	1717½ "	330 "	720 grains	75.1	61.7
7	Dracæna	"	2422 "	817 "	. . . . .	75.5	62

After an inspection of this table, the average rate of evaporation for soft thin-leaved plants, in clear weather, may be put down at about one and a quarter ounces per day (twelve hours) for every square foot of surface. The Lantana shows nearly two ounces to the square foot of surface. The camellia, with its dense smooth leaves, averaged less than half an ounce to the square foot of surface, per day.

* * * * * * A few calculations may serve to impress the importance of the ratio of transpiration deduced from these experiments. According to the above rate the Washington elm, at Cambridge, a tree, it is stated, of no very large size, with its 200,000 square feet of leaf surface, would transpire seven and three-quarters tons of watery vapor in twelve hours (day), clear weather.

Carrying the calculation further, a grove consisting of five hundred trees, each with a leaf surface equal to that of the elm mentioned, would return to the atmosphere 3906 tons of aqueous

[1] Compare this with journal for March, 1878, p. 160.

vapor in twelve hours. Even supposing this to be much over-estimated, it may very fairly be concluded from the facts given that the evaporation of watery vapor from plants is a powerful agent in maintaining the humidity of the surrounding air.

Some scientific critic might claim, as an objection to the latter assertion, that the amount of vapor exhaled from plants, though in itself large, is inconsiderable when compared with the evaporation from the surface of the earth. This seeming objection may, perhaps, best be confronted by a few calculations, and we first inquire what is the relative vaporization from a given area of leaf surface, and an equal area of earth surface? Taking the average rate of transpiration for soft, thin-leaved plants in clear weather to be one and a quarter ounces per square foot, and multiplying this by the number of days in a year the product would be twenty-seven pounds, or an equal number of pints. Now by reducing twenty-seven pints to cubic inches and dividing the result by the number of square inches in a square foot (144) we must obtain the depth in inches of the water transpired in the course of a year, about five and two-fifths inches. To continue our reckoning, we will next attempt to show the mathematical relation between the extent of the leaf surface of a section of country and the surface of the earth of the same section. According to the census returns for 1875, the percentage of woodland of the entire area of the United States, including Territories, water surfaces, cities, highways, etc., is 25; that is to say one-fourth of the total area is woodland. Now if we suppose every 900 square feet of forest land to contain one tree, and estimate each tree to be one-thirteenth the size (only) of the Washington elm, at Cambridge, we shall have about one-third of an acre of leaf surface for every tree; then it will not require much mathematical skill to understand that by multiplying the supposed leaf surface of each tree (one-third acre) by the number of trees per acre, and this in turn by the fraction one-fourth, or the proportion of woodland in the United States, the product will be four to one in favor of leaf surface over the total area of land surface. We have seen that according to our calculations the depth of transpiration per year for soft, thin-leaved plants is about five and two-fifths inches, but this must be an over-estimate, for the plants are actively giving off watery vapor only about five months of the year, that is, out of doors. We shall, therefore, suppose five-twelfths of five and two-fifths inches

or about two and one-fourth inches to be the yearly depth. Now if all the water transpired from this leaf surface were given off from a surface equal to that of the land area, we should find on a little reckoning that the depth of transpiration would be nine inches. It is to be remarked that transpiration from the grasses, cereals, underbrush, etc., was not considered in these calculations, but there can be no doubt as to their great assistance in this process; so that, were it possible to form anything like a correct estimate of the amount exhaled by these humble specimens of the vegetable kingdom the ratio would be greatly increased.

In our Southern States, many of which have as high as fifty per cent. of woodland, the depth for plant exhalation must be much greater, equivalent to at least eighteen inches, since the conditions are so much more favorable. All will agree that this is no mean showing for transpiration as affecting the proportion of moisture in the atmosphere, the yearly average rainfall being forty-three inches at Philadelphia.

There are evidently many inaccuracies in a computation like the foregoing, which it is exceedingly hard to avoid, but the allowances made will, it is hoped, meet the discrepancies and thus the true mark will not have been overreached.

Provided our reasoning be at all correct, the objection of our philosophic critic cannot have any weight, and the important fact remains established, that *transpiration is capable of increasing the humidity of the air.* Now, if transpiration so materially affects the quantity of the moisture in the outer air, what must be the effect of keeping plants in closed apartments? This question will here be discussed, and especially the effect of plants on the air of rooms heated by hot-air furnaces. According to the above extract it will be seen that the process is only about half as active indoors as in the open air, during the day, but at night the rate of transpiration is about equal in the two situations, so that during the whole twenty-four hours the quantity a plant would transpire indoors exceeds half what it would transpire in the open air, and we may presume from this fact alone that plants in rooms would influence the relative humidity of the air of the rooms.

From observations which I have made over a period of several weeks on the air of my private reading and sleeping room at the Episcopal Hospital (Philadelphia), which is kept warm by air heated by steam, and simultaneously on the air outside, it was

found that the air in the former position was appreciably dryer than the latter, the average complement of the dew point being on the whole about five degrees greater. The room adjoining mine, occupied by my colleague, was very kindly left for a time at my disposal; in it were kept a few plants in pots with a leaf surface of not more than twelve square feet. The dimensions of the rooms were similar, each being twenty feet long, eleven feet wide and sixteen feet high. Each had one window fronting east, in which the plants were kept. The average temperature and dew point in both these rooms were noted simultaneously, and the results showed uniformly, for a period of eighteen days, that the complement of the dew point averaged one and a half degrees less in the room containing the plants. These observations were made during the early part of April, 1878, when very little heat was required, still the windows were kept closed during the day. Calculating from these results, the effect of twenty-four square feet of leaf surface on the air of a room half the size of the above would be to increase the humidity sufficiently to raise the dew point six degrees Fahrenheit higher than it would be if there were no plants in the room. There can be no doubt but that a southern exposure of the plants would make the difference even greater.

As it seemed possible that the variation in the amount of moisture in the two rooms tested might be due to considerations other than the presence of plants, it was deemed necessary to vary the conditions and make further observations. Accordingly after placing some plants in the window of my own room, I took the average temperature and dew point, and compared them with those of an adjoining room containing no plants. No artificial heat was required during the time of these experiments. It was found that when the window was kept open so as to cause very free ventilation, no appreciable difference in the humidity of the two rooms was observed; but if the windows were closed for a few (say three) hours, it would make a difference of from one and a half to two degrees Fahr. in the complement of the dew point; the room having plants showing the lesser complement. This difference was maintained, almost, when the windows were opened just enough to allow a gradual interchange of the contained air; but as before intimated, a draft, though it might hasten transpiration, would, by carrying off the

vapor, prevent an increase of moisture in the air of the room. On days when the air was laden with moisture, no difference in the dew point was noticed, there being at such times little or no exhalation of watery vapor. The observations taken at 1 o'clock P. M., gave the greatest variation, the morning observations usually the least. We do not wish to say dogmatically that there is no possible chance of error in these experiments, but since they were corroborative throughout it seems fair to conclude that they are correct. Since it is allowable always to make logical deductions from facts, we may justly conclude, from the statements made in the above extract concerning the rate of transpiration, coupled with the carefully conducted observations here detailed, that during the summer months when the windows are thrown widely open and the doors kept ajar, the influence of transpiration is quite inconsiderable; on the other hand, when the interchange of air is not too rapid a sufficient number of plants, well watered, have the effect (if the air be not already saturated) of increasing the amount of moisture to a considerable extent.

As before intimated, it is my wish to apply the results of these researches particularly to the atmosphere of apartments heated by means of hot-air furnaces, which are known to be dryer than air heated by a stove or open fire-place. Not having the opportunity myself at the Hospital of comparing the dryness of air thus heated with that of the outer air, my wants were made known to a friend residing in a house heated by a dry-air furnace. Through the kindness of this friend reliable observations were made for a period of eight days. The results showed the mean average complement of the dew point to be seven degrees Fahr. greater for the heated air than the air outside. Now, according to our line of reasoning, a certain number of plants would bring up the humidity to that of the external air. Calculating from the above data, half a dozen each with a leaf surface of four square feet would be sufficient to produce this effect in a room twelve feet long and ten feet wide with a ceiling twelve feet high. The mean average temperature and dew point for the out-door observations were fifty-six degrees and forty-one degrees Fahr. respectively, which is a percentage still considerably below the healthiest standard. Some one, not a professional medical man, might pertinently ask: What is the effect on the system of air heated by a hot-air furnace? It will be necessary to answer this

inquiry only so far as relates to the effect of dry air at the ordinary temperature of such rooms.

If an apartment is heated to sixty-five or sixty-eight degrees Fahr., a person in good health and in ordinary clothing feels comfortable and experiences no immediate inconvenience. But the air contains a much smaller proportion of vapor than if the air were warmed to the same degree by a stove or open fire-place. In this manner a great demand is made upon the system to supply the air with moisture, the skin and pulmonary mucous membrane are dried, and a condition is induced which is expressed in irritability of the nervous system, paleness and susceptibility of the skin to cold, liability to pulmonary diseases, and, in a word, deterioration of all the functions.[1]

Now, it will not be doubted by any one, that if, as we have attempted to point out, the presence of a certain number of thrifty plants in an occupied apartment, warmed by dry air, would have the effect of raising the proportion of aqueous vapor to the extent indicated, plants in rooms heated by a hot-air furnace would in a hygienic point of view, be of very decided value, since they may become the means of obviating very distressing symptoms, or even disease itself. Indeed, the circumstance of so large a portion of the population of cities and towns using the hot-air furnace as a means of heating their dwellings would seem to justify the conclusion that there is a connection between their bodily ills and this method of heating, that one might be traceable, in part, to the other. It is true there are good uses of dry heat for the relief of certain diseases, but it requires a judicious application—a knowledge of the conditions in which it is indicated; it should be employed only when prescribed by a regular physician. In his very able paper, Prof. Pettenkofer wisely considers the impression which plants (and plantations) make upon our mind and senses to be of hygienic value. And, furthermore, he says: "I consider flowers in a room, for all to whom they give pleasure, to be one of the enjoyments of life, like condiments in food." May we not now rightfully consider plants kept in rooms under proper regulations to be of sanitary value also on account of their influence over the proportion of vapor in the air? And of the two effects is the latter not worthy of being made the paramount consideration?[2]

[1] Stillé Therapeutics, Vol. i, pp. 637–8.

[2] The following letter was received from my estimable friend as an acknowledgment of my paper on the Transpiration of Plants, which appeared in the March

Before passing to the consideration of moisture in the air as a means of lessening terrestrial radiation, which we have designated as the indirect effect of transpiration, it seems appropriate to give a place to a few of the laws governing radiation in general.

Radiation has been defined by Tyndall as a vibratory movement which begins in the ultimate particles of matter, and is propagated through waves of ether.

Different bodies absorb heat and radiate the same in degrees varying with their molecular constitution; that is to say, some bodies disturb the ether to a greater extent than others. It is an all important and universal law, that the power of a body to absorb heat and its power to radiate heat are reciprocal. Heat rays are emitted from both luminous and non-luminous bodies. The theory now almost universally accepted is, that heat and light are similarly transmitted; a ray which will give rise to the sense of heat by falling on the surface of the body will, if it fall on the retina, produce the sense of light, in general terms. Though the ray itself is the same in both instances, it is called, in the one case, a calorific ray, and in the other a luminous ray, on account of the effect produced. The only advantage in retaining these terms is convenience in communication. Bodies which allow the rays of light to pass freely through them are said to be transparent, on the other hand, bodies which allow radiant heat to pass through them are said to be diathermic. It

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number of this journal. The author of the letter not being aware, at the time of writing, that the present paper was in preparation.

J. M. ANDERS, M.D.

My Dear Dr.—I have read your "Transpiration of Plants" with much satisfaction. The amount of water exhaled is so greatly in excess of what I supposed to be the usual quantity, that it leads me to believe that the common opinion of physicians and laymen, that plants are injurious in the sick room, is wholly erroneous. I say the common opinion—I might say the universal opinion—for I have seldom, if ever, heard a favorable opinion of the practice expressed by any one; and yet I may not be well read in the literature of the subject, for, in your closing paragraph you say: "The practical advantage of keeping plants in occupied rooms, in which the air is generally drier than that outside, has also, from the results obtained, received further demonstration."

I am tempted to ask you where you have ever seen the "advantage" of the practice spoken of? I speak now of plants in the sick room. Your paper has brought to me new thoughts, and carried me back over a practice of half a century to see what confirmation of the advantage of the practice I can bring forward. Physicians have often spoken to me against the habit of some people who have growing plants in the sitting room occupied by the family, and especially in rooms occupied by con-

is well known that the property of transmitting light is possessed by bodies in different degrees; their ability to transmit heat has been found to be equally diverse. Now the diathermancy of substances is greatly influenced by certain conditions, among which may be mentioned, more particularly, the nature of the molecules of the body, its thickness, and especially the source or kind of heat. The rays which are not transmissible through a body are absorbed by it, thus elevating the temperature of the body; when the body is perfectly diathermic, however, there is no elevation of temperature. Now, since the absorption and radiation of heat are reciprocal, it is interesting to know how the atomic constitution of the body is affected in these processes. The rays on striking a body are some of them absorbed and heat the atoms of the body, when each of these atoms acts as a heated body itself, and emits the rays absorbed, in all directions. It has been proved that absorption does not take place on the surface, but within the absorbing body, a certain thickness being necessary to effect the phenomenon.

As the substance with which we are most concerned is in the gaseous state—aqueous vapor in the air—we shall pass to the consideration of the radiation and absorption of gaseous substances. When we reflect that some solid and liquid bodies are almost or entirely diathermic, it would, at first sight, appear absurd to talk of gases absorbing and radiating heat. One would

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sumptive patients; but I have never heard any physician advise that plants should be placed in the sick chamber as a remedial measure. I hope your experiments will lead to a change of opinion on this subject—a change which you seem to anticipate—for if the exhalation really be so great, we have it in our power to regulate the amount of moisture in the sick room. Year after year new health resorts are urged on the public; abroad there are many; and in this country, from St. Augustine to Minneapolis, they are to be found in every State, the low, warm, moist places of the South, the cool mountain regions of the Middle States, and the cold, dry climate of Minnesota. Consumptives rush to every new place only to find, in a short time, that, like the others, it must be given up as useless. Science has no influence in the choice of places. Allow me to speak of a case which in this connection may interest you.

My mother, her two sisters and only brother all died of consumption under fifty years of age. On my father's side there was not a taint of any disease, but great strength and vigor. All the children of my mother's sisters and brother, though they lived to a good age and enjoyed good health, finally died of consumption. Three of my brothers, active, energetic men until within a few years of their death, died of consumption at the ages of 55, 57 and 78 respectively, and a sister died of the same disease at 66. I mention these cases to show that the germs of the disease were with the family. Thirty years ago my eldest sister, then above fifty years of age,

suppose from the circumstance that the spaces between the molecules are so much greater in the case of the gases than in solids or liquids, that no such thing as the interception of rays by these separate particles could occur. But recent, very ingenious and delicate experimentation by Prof. Jno. Tyndall has placed the fact beyond the domain of mere reasoning, that gases do intercept radiant heat, in other words, absorb and radiate calorific rays. It would be outside the limits of the present writing to describe the apparatus used and the methods pursued. Suffice it to allude to the results obtained by this investigator, and the conclusions arrived at by him. The correctness of these results will doubtless be readily conceded after a perusal of his admirable work on " Radiation," where everything is fully explained.

In experimenting with olefiant gas and sulphuric ether vapor, it was found that the densities of these two gases may be reduced vastly below that which corresponds to the atmospheric pressure, and still they were capable of arresting undulations of heat. On investigating some of the permanent gases, as carbon dioxide, nitrous oxide, etc., he found extreme variations in absorbent powers. The heat-absorbing capacity of hydrogen and of dry air were found to be inappreciably small, while carbon monoxide, carbon dioxide, etc., were found to be active absorbents. Considering the absorbing capacity of dry air one, that of carbon dioxide, would be ninety. Experiments with ozone place this

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was reported by her physician, Dr. J. P., a victim of tubercular consumption, to which disease she would succumb before the coming summer. She was a lover of plants and flowers, and cultivated them in-doors and out. The spring saw her again moving among her plants, and the winter found her confined to the house, and sometimes for weeks to her bed-chamber, which, like the sitting-room, was literally a green-house. Visitors and friends often spoke to her of the impropriety of having so many growing plants in her room, reminding her of the tradition that they were injurious. Still, every spring found her again on her feet, in the yard and garden, nursing her plants, and every winter confined to her room. And thus she lived, year after year, until two years ago when, at the age of 85, she passed away. I have seen a few others have plants growing and blooming in their chambers, but never one who so lived among them as did my sister. Winter after winter we looked for her death, the cough, expectoration and weakness justifying our apprehensions, and yet her 85th year found her cheerful and happy, living among her plants and enjoying the society of her friends. May we not believe that the vast exhalation from these plants—water purified and medicated by their vital chemistry—prolonged her life? The results of your experiments will awaken hought, and lead to observation on the influence of growing plants in the chambers of the sick. Truly your friend,

HIRAM CORSON.

substance in the foremost ranks as an interceptor of radiant caloric.

These researches by Prof. Tyndall were extended, also, to vapors of different bodies, such as sulphuric, boracic and formic ethers; and determined them to be highly active in interfering with calorific rays, boracic ether "exceeding any other substance hitherto tried." All the experiments above quoted are certainly of great scientific interest and importance; but happily this illustrious scientist did not omit to study the effect on radiation of the aqueous vapor constantly in our atmosphere. The quantity of vapor of water contained in the air is, however, very small indeed, constituting only about four and a half per cent., and, although the moisture is everywhere present, its ratio is very variable. It is perfectly invisible, so that by our senses we are quite unable to judge of the amount present; even the purest sky may contain a large proportion. As this vapor is to all intents and purposes a gaseous body, obeying the laws of gases, any one not familiar with the information which we have just outlined, would, doubtless, hesitate to accept the assertion that the watery vapor so sparsely scattered through the atmosphere is the main agent in regulating the nocturnal radiation from the earth's surface. Even Tyndall, himself, neglected for some time this substance; and, in his own phraseology, "could hardly credit the first result, which made the action of the aqueous vapor of the laboratory fifteen times that of the air in which it was diffused." But this result does not show the correct relation of the action of vapor and air; for after repeated experiments with air from different localities and examined similarly, the results were uniformly to the effect that vapor of water has an absorbing capacity seventy times that of the air in which it is contained. Many objections and criticisms, some of which seemed almost insurmountable, were overcome by varying the methods of procedure. The assertion made above, therefore, seems to have been fully and satisfactorily demonstrated by a most careful and competent experimentalist.

Still further testimony might be adduced, the result of observations of meteorologists. Col. Richard Strachey, an eminent meteorologist, made observations showing the relation between the tension of the aqueous vapor of the atmosphere and the fall of the thermometer during the night. A single statement taken

from his results will be sufficient for our purpose, namely: "When the tension of the vapor was 0.888 inches the fall of the thermometer was 6.0° Fahr., and when the tension was only 0.435 inches the fall amounted to 16.5° Fahr." It is fair to state that these observations were conducted long before Tyndall's researches with aqueous vapor, and are on this account all the more valuable. The evidence we have adduced seems to show conclusively, that the vapor forms a sort of invisible canopy separating the chilling air above from the warm earth beneath, and arresting, more or less effectually, the radiation. We have a homely illustration of this when we see the thrifty housewife spread coverings over the more delicate plants of her flower garden on nights when she fears a frost. It has been said that aqueous vapor is a blanket more necessary to the vegetable life of England than clothing is to man; and every plant capable of destruction by freezing would succumb, if this vapor were removed for a single night. In support of this assertion it will be well to notice the results obtained by some noted observers concerning the daily fluctuation in temperature in other countries. Dr. Livingston[1] has observed a great excess in nocturnal chilling when the air is dry over that which occurred when it is laden with moisture. He has found in the southern central portion of Africa, during the month of June, the thermometer early in the mornings at from 42° to 52° Fahr., at noon 94° to 96° Fahr., or a mean difference of forty-eight degrees between sunrise and mid-day. He says, furthermore: "The sensation of cold after the heat of the day was very keen. The Balonda at this season never leave their fires till nine or ten in the morning. As the cold was so great here, it was probably frosty at Linyanti; I therefore feared to expose my young trees there."[2] Crossing the continent, Dr. Livingston reaches the Zambezi at the commencement of the year. He gives the following description of the change felt on entering the valley of the river:

We were struck by the fact that as soon as we came between the range of the hills which flank the Zambezi the rains felt warm. At sunrise the thermometer stood at from 82° to 86° Fahr.; at mid-day in the coolest shade, namely, in my little tent, under a shady tree, at 96° to 98° Fahr., and at sunset at 86° Fahr. This is different from anything we experienced in the interior.

[1] Livingston's Travels, p. 484.

[2] Livingston's Travels, p. 484.

Proceeding toward the mouth of the river (Jan. 16th), he makes the following additional observation:

The Zambezi is very broad here (at Zumbo) but contains many inhabited islands. On the 16th we slept opposite one called Shibanga. The nights are warm, the temperature never falling below 80°, it was 90° Fahr. even at sunset. One cannot cool the water by a wet towel round the vessel.[1]

Evidently the air was nearly saturated with moisture in the latter locality, and this affords the only explanation of the evenness of the temperature here.

In Australia the daily range of the thermometer is extremely great. The observations of Mr. W. S. Jevons[2] are of much interest, and we give an extract:

In the interior of the continent of Australia the fluctuations in temperature are immensely increased. The heat of the air, as described by Capt. Stewart, is fearful during summer; thus in about latitude 30° 50″ S., and longitude 141° 18′ E., he writes: "The thermometer every day rose to 112° or 116° in the shade, while in the direct rays of the sun from 140° to 150°." Again, "At a quarter past three, P. M, on January 21st (1845), the thermometer had risen to 131° in the shade and 154° in the direct rays of the sun. * * * In the winter the thermometer was observed as low as 24°, giving an extreme range of 107°" From these data we are not surprised to hear him remark further on, that, "The fluctuations of temperature were often very great and sudden, and were severely felt." He says, moreover, "It thus appears that even close to the ocean the mean daily range of the Australian climate is very considerable. It is least in the autumn and greatest during the cloudless days in spring." After giving here a table of the seasonal variation of the rainfall in Australia, Mr. Jevons says that, "It is plainly shown that the most rainy season of the year on the east coast is the autumn, that is, the three months, March, April, May. The spring season appears the driest, summer and winter being intermediate.

Prof. Tyndall says:[3]

Without quitting Europe we find places where, while the day temperature is very high, the hour before sunrise is intensely cold. I have often experienced this in the post-wagons of Germany; and I am informed that the Hungarian peasants, if exposed at night, take care, even in hot weather, to protect themselves by heavy cloaks against the nocturnal chill.

All this evidence should be sufficient to convince the most

[1] Livingston's Travels, p. 575.

[2] Quoted by Tyndall.

[3] Discourse on radiation through the Earth's Atmosphere.

skeptical that aqueous vapor furnishes a very effectual barrier to terrestrial radiation.

The tropical torrents can be accounted for by the property vapor has to absorb and radiate heat, thereby condensing the vapor raised from the equatorial regions through the direct rays of the sun. But it is only the upper strata of the vapor bed covering the surface of the earth, which by radiating into open space produces the effect above stated. Owing to the same quality may be explained the formation of cumuli; the theory of sereim, or the falling of the exceedingly fine rain shortly after sunset in the fine season. These and many other meteorological phenomena receive their solution from the development of this property of aqueous vapor. Every one will readily acknowledge that a question affecting so materially important sciences as the one under consideration, should be quite definitely settled, and it is for this reason that so much stress, by way of testimony, has been here placed upon it.

Admitting then that the vapor in the air does, by the property above discussed, influence numerous climatic conditions, the sources of this vapor certainly should claim a larger share of attention.

Nature's chief means of furnishing this moisture is through vaporization from the ocean, especially in the tropics; but many tracts of country inland, or even near the great seas, do not, for some reason, contain sufficient moisture. Now, if by any means at our command we can assist nature in supplying this very essential substance, it would be well worth our endeavors. Here the question presents itself, "Is there any connection, all things considered, between the proportion of moisture in the air and forest growth?" This question has been the subject of a great deal of discussion among able scientists, and we believe the balance of argument is in favor of the theory that there is a relationship existing between vegetation and the humidity of the air. The writer hopes he may have been successful in showing that a large proportion of the atmospheric vapor may be accounted for through the process of transpiration from plant life, that is, where there exists a fair percentage of woodland, say from twenty-five to thirty per cent.; so that now the above query may, we think, be answered in the affirmative. Under these circumstances the practice of forest culture as a means of improving atmospheric conditions, cannot be too highly commended.

MODES OF SPREADING AND MEANS OF EXTINGUISHING THE MAPLE-TREE BARK-LOUSE.

BY EMILY A. SMITH.

IN the October number of the AMERICAN NATURALIST I gave the life history of *Lecanium acericorticis* Fitch, and now conclude with the modes of spreading and the best artificial means of destroying the insect.

The disposition of the female to remain upon the same tree throughout its entire existence renders the modes of spreading from tree to tree incidental to outside influences. They are conveyed from one locality to another by the transportation of the trees while the females are upon the limbs, and are so nearly the color of the tree itself that without a magnifier are easily overlooked. The waxy mass exuded by the female in which she deposits her eggs, contains a sweet substance which is much sought after by various species of flies and wasps. When the young insect emerges from the egg, the tendency is to wander about for a time before settling upon the leaves, and the presence of the wasps and flies upon the tree in search of food at this time attracts the young lice and they attach themselves to their hairy legs and are thus conveyed to other trees. The wind and rain detach the egg-mass from the limb and convey it to other localities while the eggs are yet within.

The *L. acericorticis* are kept somewhat in subjection by the aid of the natural enemies and parasites found preying upon them; but when they increase beyond the power of these friends of ours to control them, artificial means must be resorted to.

The experience of the past summer differs from that formerly known in that the insects were found upon all parts of the tree instead of remaining upon the lower branches as was heretofore supposed. They are thus made more difficult to reach. When the lice are first hatched they are very small and delicate. A wash containing an alkaline solution applied at this time is sufficient to destroy them. I found that by attaching a wire bag to a common sprinkling hose, filling the bag with soft soap and turning on the water, a soap-suds was formed which would at once kill the insects; the scarcity of the water system in small cities renders this plan impracticable, and experiments led to one plan, easily attained by all, and which proved successful the past season.

The plan recommended is as follows: Charge a fire extinguisher in the usual manner with bi-carbonate of soda and sulphuric acid; add to the water one spoonful of crude carbolic acid to every eight gallons of water. Apply this to the tree and the force from the extinguisher will convey the fluid to all parts of the tree alike; the disposition of the insects to settle upon the lower surface of the leaf and limb serve to further this plan. Two applications should be made upon the same tree; the first, three weeks after first deposition of eggs, and the second, four weeks from the first application. If the work is delayed the insects become strong and the strength of the solution must be increased, which would be liable to injure the tree itself. The actual cost is not exceeding twenty cents an application, which is trifling compared to the cost of replacing the tree. That the experiment may prove successful it is necessary to make the work thorough throughout a locality, since in a short time they return from the infested trees.

Examining the male *L. acericorticis* since my previous article, I find my doubts confirmed with reference to the non-existence of the two halters or balancers in the place of lower wings. After close examination with a high power and living specimens, I fail to find them, and conclude that in this species they do not exist, or if at all, in a rudimentary state.

M. V. Signoret states that when the male *Lecanium* is prepared to come out it lifts that membrane which rests slightly fixed by the head end. Observation with this species shows this is not reliable with all *Lecania*. When the male of this species is about to emerge from the larval scale, it backs out with the wings closely adhering to the body. The empty scales will, upon examination, be found closely attached to the leaf or limb at the head end, while at the opposite end it is loosened.

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RECENT LITERATURE.

MACALISTER'S ZOÖLOGY OF THE VERTEBRATES.[1] — This little manual is chiefly concerned with the morphology of the classes and orders of vertebrate animals, with slight, condensed references to their habits, physiology and classification, but with no chapters treating of their zoö-geographical distribution, or geological suc-

[1] *Zoölogy of the Vertebrate Animals.* By ALEX. MACALISTER, M.D. Specially revised for American Students, by A. S. PACKARD, JR., M.D. New York, Henry Holt & Co., 1878. 12mo, pp. 134, with 59 figures.

cessors, or their relations to lower forms of life, or to their environment; nor is anything said regarding the mode of development of these animals. However, as a compact, concise, clearly written and useful manual of the morphology of vertebrates, it is well adapted for the use intended by the author, viz: "To present in as clear a form as possible the leading characters of vertebrate animals." As such we recommend its use in colleges and high schools, and to the general reader, though in these days the latter class of book buyers desire, as a rule, a book combining morphology and biology, with general views of the relation of animals to their surroundings, as well as their relations to fossil forms. It should, however, in justice be said, that all this could not be contained in a book of the size of the present one.

While we have no fault to find with the matters of detail, we would suggest that in the light of recent discoveries, it is old-fashioned and unphilosphical to regard the fourteen groups of carinate birds as "orders."

The wood-cuts are from well selected subjects, and are, with scarcely an exception, excellent, while the paper, press-work and binding render this little hand-book, like others of the series, both attractive and convenient.

FOSTER AND LANGLEY'S ELEMENTARY PRACTICAL PHYSIOLOGY.[1]—This well known book, so useful to students of anatomy, histology and physiology, has passed to a third edition, which differs from the preceding one chiefly by the introduction of a lesson on the structure of the ear, and by some additions to the lessons on the connective tissues. As it now stands the book is indispensable for medical students, and for biologists who have used Huxley and Martin's Biology and desire to extend their studies to histology and physiology. Its extensive use among naturalists is most desirable, to draw them away from "skin and bone" as well as systematic zoölogy, to a study of the living organism, and thus ultimately to the more general relations of animals to each other and their environment.

IHERING'S PERIPHERAL NERVE-SYSTEM OF VERTEBRATES.[2]—This elaborate essay treats of the following subjects: The peripheral system of nerves as regards the knowledge of the formation of regions in the vertebral column; the idea of segments in the vertebrates and invertebrates; a general phylogeny of the peripheral nerve-system and the formation of regions of the vertebral column. The chapters on these subjects are followed by a special account of these nerves in the different

[1] *A Course of Elementary Practical Physiology.* By M. FOSTER, M.D., F.R.S.; assisted by J. N. Langley, B.A. Third edition. London, Macmillan & Co., 1878. 12mo, pp. 276.

[2] *Das Peripherische Nervensystem der wirbelthiere als Grundlage für die Kenntniss der Regionenbildung der Wirbelsäule.* Von HERMANN VON IHERING. Mit 5 tafeln und 36 holzschnitten. Leipzig, Verlag von F. C. W. Vogel, 1878. 4'o, pp. 238.

classes of vertebrates. Regarding segmentation in vertebrates as compared with invertebrates, our author considers the body-segment of a vertebrate not as a single organ, but as the combination of a neuromere arising from the ectoderm with the scleromere and myomere arising from the mesoderm, which arise independently of each other and are not in any way to be taken together. Such an antithesis between the neuromere and the other organ-segments do not exist in the segments of the Articulates. Ihering also expresses the opinion that Semper's revival of the hypothesis of Geoffroy St. Hilaire and Treviranus is a matter rather of personal convictions than a subject for scientific discussion. This hits the nail on the head. He also shows that in vertebrates the new segments of vertebrates, in early life, are terminal; while the new segments of articulates are interpolated between the penultimate and terminal segments of the body. The law for articulates is not new to American students,[1] though only German and Swiss authorities are quoted in the present work.

THE PRINCIPAL CHARACTERS OF AMERICAN CRETACEOUS DINOSAURS.—Prof. Marsh, in the November number of the *American Journal of Science and Arts*, gives an account of the characters of several genera of saurians from the Rocky Mountain region. This paper gives us, for the first time, the characters of their ilium and the mode of its junction with the pubis and ischium, and the structure of the feet and of the axis vertebra, all points of great value to comparative anatomy and palæontology. He also extends to certain genera, characters of the skeleton which have been already determined in nearly allied forms. He proposes for them all a new division of the *Dinosauria* which he terms *Sauropoda*, with the following definition: (1.) Fore and hind limbs nearly equal in size. (2.) Carpal and tarsal bones distinct. (3.) Feet plantigrade, with five toes on each foot. (4.) The precaudal vertebræ contain large cavities apparently pneumatic. (5.) The neural arches are united to the centrum by suture. (6.) The sacral vertebræ do not exceed four, and each supports its own transverse process. (7.) The chevrons have free articular extremities. (8.) The pubes unite in front by ventral symphysis. (9.) The third trochanter is rudimentary or wanting. (10) The limb bones were without medullary cavities.

We remark, with reference to the above definition, that it embodies the characters of a well-marked division of reptiles, but that many of the characters given do not have such significance; or, in other words, do not possess the value which Prof. Marsh attaches to them. Thus, while some of them should be retained, **Nos. 1, 4, 5, 7 and 10 must be rejected.**

An important improvement over his previous essays is noticeable in this one, in that the author gives a definition for the only new genus proposed, viz: *Diplodocus*, which is, therefore, a real addi-

[1] See Packard's Guide to the Study of Insects.

tion to scientific nomenclature. But, on the other hand, Prof. Marsh does not deviate, throughout this paper, from his usual habit of ignoring the work of contemporary naturalists.[1] We cite the following instances: The division called by Marsh *Sauropoda*, was named by Owen, thirty-seven years ago, the *Opisthocœla*, and more recently by Seeley, the *Cetiosauria* (the latter name without definition). Several genera of the group have been determined by other authors, of which no mention is made, while new names are given them. Such is *Caulodon*, which at a later date is termed *Morosaurus;* and *Camarasaurus*, from which *Atlantosaurus* of later origin has never been distinguished. The name *Apatosaurus*, introduced as "described by the writer," is an equally unknown quantity in palæontology.[2] The various descriptions of the characters of the limb and pelvic bones, and of the skeleton in general, are all given as though new, the recognition of work done by others, usually thought indispensable in scientific literature, being quite omitted. A reference is made, however, to the early determination of the age of the beds in which some of these fossils were found by Dr. Hayden and Prof. Cope, as erroneous; but the author fails to notice the later views of Prof. Cope, in which he corrected both Prof. Marsh[3] and the determinations which were made before him.

MEEHAN'S NATIVE FLOWERS AND FERNS.[4]—We are glad to notice the increasing number and value of our popular works of natural history. Such handbooks have long been common in England and on the Continent, but somehow we, in America, have not had them. Works like these, however, seem now to be much in demand. They undoubtedly have, when well conducted, an educational influence. The name of Mr. Meehan is a guarantee for the excellence of the text. He gives a pleasant conversational account of each flower, and contrives at the same time to introduce much interesting scientific matter, which may lead the reader to personal research. Herein lies the value of these illustrated manuals. He who comes to them for amusement may tarry for information. One part is to be issued every two weeks, and will contain four colored plates. Mr. Alois Lunzer has here produced very satisfactory work. Indeed, we are at a loss to see how the Messrs. Prang & Co. can furnish so much for so small a sum; the price of each part is but fifty cents, while both letter-press and plates are elegant. A somewhat familiar acquaintance

[1] An apparent exception, is that of a distinguished English palæontologist, who is noticed in a foot note, but his precise service, that of the determination of the structure of the pelvis in *Iguanodon*, is unfortunately not specified.

[2] I note here that the supposed new genus of *Mammalia* recently noticed by Prof. Marsh as derived from the same beds, is in a similarly unsatisfactory condition, not the least ground for its creation having been given.

[3] Proc. Amer. Philos. Soc., 1877, p. 234.

[4] *The Native Flowers and Ferns.* By THOMAS MEEHAN. Boston, L. Prang & Co., 1878.

with our wild flowers in most of their moods, makes us critical in a few instances as regards shades of color. But where there is so much that is excellent, the office of fault-finder is gratuitous. We especially commend the drawings of *Pachysandra procumbens* and *Polypodium incanum*. In still another respect this work has a direct scientific bearing, as Mr. Meehan introduces so many references to current botanical literature. The undertaking ought certainly to succeed.—*W. W. B.*

TAYLOR'S FLOWERS.[1]—This little book which, in about six months, has passed into a second edition in England, should be better known in this country. The author has, with great skill, presented in a popular form the most recent results of botanical research. In so doing he has not fallen into the habit, all too common, of theorizing for himself or poetizing for others. He is in full sympathy with modern thought, and in his opening chapter on the old and the new philosophy, distinctly states his position. He shows that the time has gone by when man is to hold that the beauty of flowers, or their useful or noxious qualities were designed in reference to him alone; that it is a nobler conception, and one, moreover, sustained by facts, that they are contrived in subservience to their own needs and their special environment. This chapter in itself is a most delightful essay. In it reference is made to the researches of Darwin, Müller, Bates, Bell and others upon cross-fertilization by insects and humming birds. The author is well read in the literature of his subject. He next discusses the geological antiquity of flowers and insects, the geographical distribution of plants, their structure and their relations to their surroundings. The colors, shapes, perfumes and defences of flowers, all have appropriate treatment in special chapters, and it is impossible in a short notice to convey to the reader an adequate idea of the vast amount of information here condensed into accessible shape. The very latest data from the *Challenger* and the British Arctic Expeditions are incorporated. To add to the merits of the volume, it is superbly printed, and illustrated with 32 colored figures by Sowerby, together with 161 woodcuts.

Says the author: "Every day we are proving that 'man liveth not by bread alone'; and that sunny blue skies, laughing streams, and flower-bedecked fields are full of lofty and even spiritual teachings. The organic unity of Creation, for which thinkers have long sighed, and labored, and suffered, has appeared above the horizon, and is each day becoming more manifest to us. A clearer conception of Creational Power and Wisdom must naturally spring from more correct ideas of the laws by which the Life of our planet originated, and which still continue to govern it."

In conclusion, this is a book which we would gladly put into

[1] *Flowers; their origin, shapes, perfumes and colors.* By J. E. TAYLOR, Ph.D., F.L.S., etc. Second edition. London, Hardnicke & Bogue, 1878. 16mo.

the hands of the young. It will, we think, stimulate to observation and even to original research. If it does no more, it must surely lead to correct and logical views of the facts of nature. It will make a good Christmas gift for thinking boys, and will afford them healthy and inspiring recreation. When saying this, however, we do not desire to convey the idea that it is in any sense a "boys' book." It offers as rich entertainment for the adult.—*W. W. B.*

FLEMING'S GEOGRAPHY OF THE CANADIAN PACIFIC RAILWAY.[1]—This report is of particular interest as giving a résumé of the knowledge recently acquired regarding the physical geography of British Columbia and the interior of British America The map, showing various projected lines of the Canadian Pacific Railway, is a compact presentation of existing knowledge of this region, and is consequently of much use to American students.

RECENT BOOKS AND PAMPHLETS.—Pacific Coast Lepidoptera, No. 26. Description of two new forms of diurnals. By Henry Edwards. (From the Proceedings of the California Academy of Sciences, December, 17th, 1877.) 8vo, pp. 14.

Sketch of the Life and Scientific Work of Prof Charles Fred. Hartt. By Richard Rathbun. (Read before the Boston Society of Natural History, April 17th, 1878.) 8vo, pp. 26.

Remarks of Robert E. C. Stearns before the California Academy of Sciences on the Resignation and Farewell of Vice-President Henry Edwards, August 19th, 1878. 8vo, pp. 3.

Surveys by the War Department. Letter from the Secretary of War in response to a Resolution of the House of Representatives giving information concerning the surveys conducted by the Department in the last ten years. Washington, May, 1878, 8vo, pp. 8, and map.

Report on the Insect and other Animal Forms of Caledonia Creek, New York. By J. A. Lintner. (From the Tenth Report of the New York State Commissioners of Fisheries, August, 1878.) 8vo, pp. 26, 3 plates.

On the Willemoesia Group of Crustacea. By C. Spence Bate. (From the Annals and Magazine of Natural History, for October, 1878.) Read at the meeting of the British Association, at Dublin, August 19th, 1878, 8vo, pp. 11, 1 plate.

Neue exotische Hesperidae. Beschrieben von H. B. Möschler. (Aus den Verhandlungen der k. k. zoologisch-botanischen Gesellschaft in Wien. Jahrgang 1878, besonders abgedruckt.) 8vo, pp. 28.

On the Mineralogy of Nevada. By W. J Hoffman, M. D. (Extracted from the Bulletin of the Survey. Vol. iv, No. 3, Department of the Interior. F. V. Hayden, U. S. Geologist-in-Charge. Washington July 29, 1878.) 8vo, pp. 15.

On the Nauplius Stage of Prawns. By C. Spence Bate. (From the Annals and Magazine of Natural History for July, 1878.) 8vo, pp. 8.

Die prähistorischen Kupfergeräthe Nordamerikas. Von Dr. Emil Schmidt in Essen a. d. Ruhr. (Hierzu Taf. iv, v, vi.) 4to, pp. 42, 3 Plates.

Journal of the American Geographical Society of New York, 1875, 76, Vols. vii and viii. Albany, 1878. 8vo.

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[1] *Canadian Pacific Railway.* SANDFORD FLEMING, C. M. G. Engineer in-Chief. Reports and Documents in reference to the location of the line and a western terminal harbor. 1878. Ottowa, 1878, 8vo, pp. 104, 3 maps.

GENERAL NOTES.

BOTANY.

VOLVOX GLOBATOR.—Although this minute organism has long been a favorite object for observation under the microscope, its structure has only recently been fully worked out by Prof. F. Cohn, of Breslau. Its reproductive organs are now found to be of a highly complicated structure, indicating its proper position in a comparatively high class of Cryptogams, with a marked affinity, in some respects, to the Fucaceæ. It must, at all events, be placed in Sachs' class Oösporeæ.

The Volvox is a minute pale-green globule just visible to the naked eye, about one-fiftieth of an inch in diameter, rolling about rapidly in clear water, owing to the action of innumerable fine, transparent vibratile cilia with which the surface is studded. These cilia are arranged in pairs, each pair belonging to a separate peripheral corpuscle or cell, each of which contains a green protoplasm-body, a minute starch-granule, a reddish brown "eye-spot," and one or two contractile vacuoles, the cilia being borne at the narrow hyaline end. Each is surrounded by a gelatinous envelope, which is pierced by a number of canals, all lying nearly in one plane, and filled by green or colorless extensions of the protoplasmic interior. Since the canals of adjoining cells correspond, the corpuscles appear as if connected together by a network of fine reticulations. The outer gelatinous wall of each cell is also perforated by two pores, through which the two vibratile cilia project into the surrounding water. These cells have, as far as is known, no reproductive function. Besides these non-reproductive or sterile cells, each Volvox colony includes three kinds of reproductive cells, non-sexual, male and female. The non-sexual reproductive cells, or parthenogonidia, are similar in structure to the sterile cells, but two or three times their size, *i.e.*, from .006 to .009 mm. in diameter. They multiply by repeated bipartition, this process having been followed by Cohn until the original cell has divided into sixteen. The young colony is surrounded by a transparent membrane, which it at length breaks through, and carries on an independent existence within the cavity of the mother colony, each of its cells developing a pair of cilia; finally it escapes into the surrounding water. The usual number of parthenogonidia which thus develop into infant colonies within the mother-colony is eight. The sexual reproductive cells are very few in proportion to the sterile cells, and appear to be formed only in the autumn, and the two kinds, male and female, are found either in the same or in different colonies; and the sexual generation forms the close of a larger or shorter series of non-sexual generations. The female cells or gynogonidia are at first undistinguishable from the parthenogonidia, but are much more numerous, and very early form chlorophyll. They

have, at first, a frothy appearance from the formation of vacuoles, but afterwards appear to be filled with protoplasm. They soon become flask-shaped, their narrow end touching the periphery of the sphere, and the larger end hanging free into the cavity. When ready for impregnation they round themselves off into a spherical form, and may then be designated oöspheres, each being enveloped in a gelatinous membrane or oögonium. The androgonidia, or male cells, also contain chlorophyll; they divide but only in two directions, thus developing not into a sphere but into a plate of cells. They ultimately resolve themselves into a bundle of naked primordial cells, each consisting of an elongated body in which the chlorophyll has been transformed into a reddish-yellow pigment, and of a long colorless beak, to the base of which are attached two very long vibratile cilia, and where also is a red corpuscle or "eye-spot." The whole androgonidium may now be regarded as an antheridium enclosed in a gelationous envelope, each of the naked protoplasmic bodies being a mobile antherozoid or spermatozoid. The movements of the vibratile cilia eventually cause the antheridium to break up, the separate antherozoids setting up a rapid independent motion within the gelatinous envelope of the antheridium, which they ultimately break through, and then move about rapidly in all directions within the cavity of the mother-colony. They assemble in large numbers round the oögonia, and some of them finally penetrate through the gelatinous envelope of the latter, and coalesce with their protoplasmic contents or oöspheres. The fertilized oösphere is now an oöspore, and develops a new cell-wall, the epispore, which is at first smooth, but afterwards covered with conical elevations, giving a section of it a stellate appearance. A second perfectly smooth membrane, the endospore, is subsequently found within the first. The chlorophyll gradually disappears, and is replaced by an orange-red pigment dissolved in oil, so that the mature oöspore, while still enclosed within the mother-colony, is of a light-red color, causing the red tinge which Volvox often presents, even to the naked eye, at certain periods of the year. Soon after the oöspores reach maturity, the mother-colony breaks up, single cells escaping from the combination, and swimming about freely in the water; their further history is unknown. The oöspores fall to the bottom and there hibernate. Their further development has only been observed by Cienkowski, who states that the contents of each spore break up into eight spheres which ultimately break out.

Full details of these interesting processes, with admirable illustrations, will be found in Cohn's Beiträge zur Biologie der Pflanzen, Vol. i, Heft 3.—*Alfred W. Bennett.*

A Double-flowered Cypripedium spectabile.—In describing this flower it is viewed as it hangs on the stem in its natural position, having a right and a left side, the observer facing the open flower.

The parts in their natural place are the outer sac, the lower sepal, the stigma and the two pollinia. The lower sepal is broader than is usual, the stigma deeply two-lobed and twice the ordinary width. The right-hand pollen-mass is doubled, the third one standing at the apex of the angle made by the two barren stamens. These stamens are of the ordinary size, and face each other at an angle of 80°. The upper part of the flower may be regarded as composed of two single flowers, together occupying about 240° of a circle, the lower sepal being the only part in the remaining space. There are a sepal and two petals on the upper left side, and the same on the upper right, each part of the usual size. The natural flower is the left one to which the outer sac belongs. Its right-hand petal is nearly vertical, where the upper sepal naturally stands. The left petal of the right-hand flower stands directly behind this, and has grown by one edge to the edge of the upper or involucral leaf, which in turn is grown by the remainder of the same margin to the ovary, so as to be adherent all the way from the base of the ovary to the top of the petal.

The ovary is enlarged, one-celled, with four parietal placentæ; some of the placentæ are uncommonly broad, and are probably doubled, though so closely connected as not to be distinguished. One sac is contained in the other, but entirely free, and readily drawn out. The inner sac belongs to the right-hand flower, its claw being a little to the left of that of the outer. Though contained in the outer, it is really larger when inflated, being crumpled as it is packed away. The flowers are large, the sacs being two inches long.

From the position of the parts, which were carefully compared with fresh specimens of the single flower, it is probable that this monstrosity arose from two buds, starting from the same point of the stem, and adhering by their inner faces, those parts only being doubled in reality, for which room for development was found, the doubling of the rest being disguised in the enlarged parts that represented them. Most of the specimens I have examined bear but two flowers, and almost always that number.

This flower was brought in a bouquet from some place in Indiana, the name of which I could not learn. It is found abundantly in the peat bogs and margin of sloughs in the pine barrens of Lake Co., Ind. I have since been told that it is not unusual to find these double flowered Lady's Slippers, though it is the first that has come under my observation, or that of any of my botanical friends to whom I have mentioned it.—*E. J. Hill.*

A New Variety of Campanula rotundifolia L.—While collecting plants in the northern part of Michigan the past summer, I discovered a form of this plant that I do not find mentioned. It differs from the ordinary forms in being densely pubescent, or hoary with short, reflexed hairs, at least on the lower part of the stem and leaves, some plants being smooth or somewhat so above.

Usually the flower alone is smooth. The stems are generally stout and clustered, from one to two and a half feet high. There are often from eighteen to twenty flowers on a stem. This abundance of flowers seems to characterize nearly all of my specimens of *C. rotundifolia* gathered along the shores of Little and Grand Traverse bays. In Gray's *Synoptical Flora*, our latest authority, the plant is said to be 1–9 flowered. Most of mine exceed this. One stem has thirty-two in different stages of growth. I propose for this variety the name *C. rotundifolia var. canescens.* It grows on sand hills at Indian river, near the outlet of Burnt lake, Sheboygan Co., Mich.—*E. J. Hill, Englewood, Ill.*

Mr. J. L. Bennett, of Providence, R. I., informs us that a form exactly similar to this, save in the abundant flowers, is found in Greenfield, Franklin Co., Mass.; the amount of canescence differs very much, even in the same plants, some stems being very nearly smooth, while others are quite hoary; different portions of the same stem also varying greatly.—*W. W. B.*

Extirpation of a Plant.—Though attributed to Southern Florida, where it is still common, the coontie (*Zamia integrifolia* Willd.) is found to extend as far north as Alachua, Bradford and adjoining counties of this State, and, at one time, I understand, was most abundant in the localities named. But of late it is comparatively rarely met with in this region, and in many wide ranges has totally disappeared. Where hogs are kept, and are allowed to roam at large, as is usually the case in Florida, the plant, I am informed, is soon extirpated, those animals ravenously devouring it, and I have traveled over many miles of this territory without meeting a single Zamia. Its stem is rich in starch, and from it is made the coarser description of Florida arrowroot. Hence its attraction for the hog. Any one who has seen, as I have, the manner in which this animal attacks and uproots so difficult a subject as the young saw-palmetto (*Sabal serrulata* R. and S.) can easily understand what short work it would make with the coontie. Belonging to the *Cycadaceæ*, its pinnate leaves and palm-like aspect give the *Zamia* a peculiarly ornamental and attractive appearance, and its vanishing from so wide a field is much to be regretted. As Florida becomes more thickly settled, the total extirpation of the plant, except in its more southern habitat, and where taken into cultivation, may prove to be a not unlikely event, from the cause mentioned, and also from its use by man in manufacturing starch and arrowroot.—*Henry Gillman, Waldo, Florida.*

The Structure and Affinities of Characeæ.—In recent numbers of the London *Journal of Botany*, Mr. A. W. Bennett and Prof. Caruel discuss this subject; both these botanists dissenting from Sachs's location of the *Characeæ* (in the fourth edition of his Jahrbuch der Botanik) among the *Carposporeæ*, a

class of Thallophytes. Mr. Bennett points out that not only do the *Characeæ* differ from Thallophytes in the most essential points of structure of that class, viz: in possessing a distinct axis and branches; they do not, either display the distinguishing characteristics of the *Carposporeæ*, viz: the formation, as the result of the impregnation of the female organ, of a sporocarp consisting of two essentially different parts, a fertile part and an envelope or pericarp which is not derived directly from the female organ. Mr. Bennett also calls attention to the fact that the term "proembryo" has been misapplied by many writers to the structure which proceeds immediately from the germination of the spore of Chara, and which is rather a prothallium or a protovum; and again that the *Characeæ* are incorrectly described by some as displaying the phenomenon of alternation of generations. The term alternation of generations implies two distinct starting points in the life-history of the plant, impregnation and germination; the sexual generation consisting of the stage intermediate between germination and impregnation, the non-sexual generation, of the stage intermediate between impregnation and germination. In *Characeæ*, almost alone among Cryptogams, the oöspore or fertilized oösphere germinates immediately in the soil without the intervention of a non-sexual generation. Caruel, for reasons assigned in his new system of classification, to which we have already referred, insists on placing the *Characeæ* by themselves as a primary group of the vegetable kingdom, under the name *Schistogamæ*, intermediate between Phænerogams and vascular Cryptogams.—*A. W. Bennett.*

Botanical News.—In a short paper by Dr. Ewart, on the Life-history of *Bacterium termo* and Micrococcus, the author regards it provisionally as distinct from Bacterium. His observations on *Bacterium termo*, especially, with reference to the effects of desiccation, of different temperatures and of ebullition will be of value in future researches of like nature. Mr. Geddes and Dr. Ewart describe also in the Proceedings of the Royal Society the life-history of Spirillum, and they conclude that "the forms described by various authors as Vibrio are merely either (1) Zigzag dividing Bacillus; (2) slightly waved Bacillus; or (3) undeveloped Spirillum, and hence that Vibrio should no longer be used as a generic term." The *New Italian Botanical Journal* for July 30, contains Delpino's defence of his dichogamic doctrine, with a brief appendix by T. Caruel, the editor. In Trimen's *Journal of Botany*, for October, J. B. Balfour describes some points in the morphology of Halophila, and G. S. Boulger contributes an article on the placenta of *Primulaceæ*. The *Bulletin* of the Torrey Botanical Club, for September, contains a list of plants introduced with ballast and on made land in Jersey City; Lists of Long Island and Staten Island and Rhode Island plants are also given. Mr. Martindale contributes to the September number of the *Botanical*

Gazette, a notice of the occurrence of *Orobanche minor* in New Jersey. Dr. A. P. Garber writes in the October number of South Floridan ferns, while Mr. J. G. Lemmon writes in rather a gushing way of the big trees of California.

ZOÖLOGY.[1]

Breeding Habits of Corixa.—In Bulletin No. 1 of the Illinois State Laboratory of Natural History, I called attention, three years ago, in a paper on the Crustacea of Illinois, to a breeding habit of Corixa, which seems to have escaped the notice of the entomologists; and as my note has also been generally overlooked by those most interested, I repeat the observation here, especially as it affords a very curious illustration of natural selection, unless I wholly misunderstand the matter.

In temporary ponds of this region, which fill up every spring and dry out in midsummer, *Corixa alternata* Say, is an abundant insect, and *Cambarus immunis* Hagen, is the commonest craw-fish. In seining some of these ponds, three years ago, in June and July, I noticed that the backs of many of the crawfishes were covered with a moss-like incrustation, which, upon examination proved to be the eggs of insects, stuck fast by one end as close together as they could be placed. Sometimes only a few would be found on a crawfish, and sometimes the upper surface would be nearly covered. They were just hatching when first observed, and it took but a little time to determine that they were unmistakable Corixas. Careful search of the water weeds and other submerged objects failed to discover other eggs, and I was led to conclude that the Corixa purposely selected this remarkable place for oviposition. Since then I have found these eggs also on the shells of pond molluscs, and on the carapace of *Cambarus acutus* Gir., another wide-spread and common crawfish.

I can account for so strange a habit only by supposing that it is a "provision of nature" to guard against the waste of eggs otherwise resulting from the drying up of the ponds. The crawfishes mentioned are distinctively aquatic species, and as one pond dries up they migrate to another, or to a neighboring stream, bearing on their hospitable backs, as the shepherd bore Œdipus from impending destruction, the hopes of the distressed water bugs. If this is a fixed habit of a species or variety, and not a local accident, it ought to be heard of elsewhere.—*S. A. Forbes.*

Snakes and Cold Victuals.—It is a popular notion that serpents never eat what has been killed by any agency except their own; and, though naturalists know this belief to be false, very few of the one hundred and thirty-two species of North American serpents have been proved by actual observation to have eaten any animal which they have not captured alive.

[1] The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

As the common black snake, *B. constrictor*, is not, to my knowledge, among the number already accredited with a propensity for cold victuals, an account of a black snake's dinner which recently came under my observation may be of some interest to those herpetologically inclined:

During the latter part of last June I killed a garter snake, *Eutænia sirtalis*, and the next day, happening past the place where I killed it, I came upon a black snake with about an inch of the tail of a garter snake protruding from its mouth. As I could see nothing of the dead snake left there the day previous, I immediately suspected the one inside his constrictorship to be the same. On removing the garter snake this proved to be the case, as was evidenced by the wounds I had made on the snake's head and body. The length of the black snake was a little short of three and a half feet, and that of his dinner, twenty-two inches.—*F. W. Cragin.*

A Skunk eaten by Turkey-buzzards.—Some years ago, while residing in Chester county, Penna., having set a steel-trap for a ground-hog (Maryland marmot), I found a large skunk caught by a leg. Though a very unwelcome prize, there seemed no alternative but to kill it, which was done. This was about 8 o'clock in the morning; immediately a number of turkey-buzzards commenced their usual gyrations over the dead body, and by 10 o'clock nothing remained of the unsavory animal but its well picked skeleton.—*William Kite.*

ANTHROPOLOGY.[1]

A Vessel of Glazed Pottery taken from a Tumulus in Florida.—The peculiar egg-shaped vessel surmounted with bulbous-shaped mouth, a description of which is here given, was found, associated with some much-decayed human bones, and a single arrow head chipped from reddish flint, in a burial mound near the south shore of Santa Fe Lake, Florida. The color of this unique piece of pottery is a dull shade of buff or drab. It is formed of yellowish clay, like that found in the neighborhood, perhaps mingled with marl; but without any admixture of crushed stone or shells being used in its construction. Its height is eleven inches, and its greatest exterior diameter 8.40 inches. It weighs six pounds, and holds over one gallon of liquid, or exactly four and one-third quarts, being perfectly water tight. Its base is too rounded to permit of its standing without support. The peculiarity of its construction is that it is built spirally from the bottom upward with one continuous cylinder or rope of clay, giving the vessel a ribbed or corrugated surface; there being twenty-four rounds or circuits of the cylinder. The entire inside is glazed with a decided but somewhat thin glazing of a pale yellowish tint. The bulbous-shaped mouth is

[1]Edited by Prof. Otis T. Mason, Columbian College, Washington, D. C.

also covered on the outside with a coating of the same preparation, which extends for the depth of about one inch below the neck, over which is a second and thicker coating of glaze of a cream color with greenish cast. With this exception the outside is unglazed. In applying the glazing, some of the material has streamed down the side of the vessel, which is also spotted in several places with drops of the vitreous substance. The glazing is in an excellent state of preservation, though marked with the reticulation of fine cracks such as may be seen in even our modern pottery when it has been in use for a considerable length of time. The entire workmanship of the specimen is of a much rougher and ruder character than the fact of its being glazed would imply. On the outside, at a point 2.30 inches below the contracted neck, occurs an annular indentation, the greatest diameter of which measures 0.54 inch, its least diameter being 0.52 inch. This, which, with the exception of the border of glazing around the neck, is the only attempt at anything like ornamentation in this piece of pottery, has some indication of being the personal stamp or brand of the maker.

It is believed th t this is the first vessel of glazed pre-historic pottery taken from a mound in Florida, or perhaps from one in any other part of the United States, or at least the first east of the Rocky Mountains, of which any account has been given. Wyman makes no mention of such, though he speaks of having "found indications that some at least of the vessels were made by coiling up long cylinders of clay, and afterwards pressing and welding them together." Dumont, in his elaborate account of the manufacture of pottery by the Indians of Louisiana, though accurately describing the forming of vessels by spirals made with cylinders of clay, is silent as to glazing. And so also with other writers. Some, indeed, make mention of glazing; but it is evident from their own explanations that simply a polishing and painting of the articles is meant, and not the vitreous coating to which the term in general is understood to apply.

It only remains to say that it is probable that the glaze on this peculiar vessel was produced by the use of salt. At least it is not of a calcareous nature, the test of acid failing to provoke effervescence.

Since writing the foregoing, my attention has been called by Mr. E. A. Barber to his interesting account in the AMERICAN NATURALIST for August, 1876, of the Pueblo pottery of the Far West, some of which is finely glazed, and which is found scattered over the surface of the country for hundreds of miles, though chiefly in the vicinity of the old mural ruins. A comparison of this highly advanced and probably much more modern pottery with the vessel here described, taken from an ancient mound in Florida, is not without its suggestiveness. Particularly is this the case from the fact that it is known that the modern Pueblo Indians

construct pottery by spirally coiling cylinders of clay, as has been above described in the case of the Florida pottery, though Mr. Barber states that they have lost the art of glazing.

Further details are given in a paper on the subject, read before the St. Louis meeting of the American Association, August, 1878.—*Henry Gillman, Waldo, Florida.*

An Indian Burial—Funeral Ceremonies at Lower Lake, California.—After the grave (a round hole of about five feet in diameter and the same in depth) had been prepared under a brush house, adjoining the cabin of the dead Indian, the body was carefully carried out in a blanket and quilt, and placed alongside the opening. The medicine man then began the funeral rites, which, in part, consisted of blowing a small whistle, and the shaking and rattling of split sticks, which made a peculiar noise like nothing but itself. After this had been kept up for some time, accompanied with the low, plaintive wails of the squaws who were sitting around the grave, and the louder lament of those in the house, the medicine man then pronounced a eulogy upon the dead, and exhorted the living. His language was accompanied with expressive gestures. He pointed to the sky, to the ground, to each of the four cardinal points, and, finally, into the grave itself, conveying the idea that after we had lived and enjoyed the things of this world, and wandered far and near over the earth, the time would come when a final separation of body and spirit must take place; and while the spirit ascended to regions above, the body must go into the ground and remain there, at least for a time. He then took the small whistle used by him and placed it in the mouth of the body, after which, with closed eyes and uplifted hand, he engaged in an invocation of some kind.

At the close of this, Rosa, the wife of the dead man, came from the house and cast herself full length upon the body. She removed the covering from Joe's breast, and, after she had laid her head upon it the covering was replaced, and her voice could be heard in low tones, as if bidding the departed a last farewell. After this a feather bed was brought out from the house and laid in the grave, the body was placed upon it in a half-sitting position; his gun, hat, shoes, some food, a basket containing silver coin, Indian money, beads, and feathers, were also put in with him. On top of all was thrown a straw bed. Rosa again began her lamentations, and, with a loud scream, tried to throw herself into the grave, but was withheld by a stout young squaw, who held her in her arms until the grave was filled. The first few handsful of dirt were thrown into the grave by the squaws; the men, then, with shovels, filled it up. After the dirt had been replaced, one of the squaws, with her hands, smoothed it over and obliterated all the tracks made by the workers. The medicine man again circles the grave three times, stopping each time at the

cardinal points, turning completely around, and finished by blowing the breath from his nose and mouth upon it.

Before digging the grave a number of chickens belonging to the dead man were killed and placed at intervals around the spot selected for sepulture, at a distance of twenty-five or thirty feet from it. The body was clothed with a new shirt and pantaloons, the forehead and eyes covered with a badge made of white beads, and a crown, or head-dress, of feathers above all. The cries and lamentations of the women were so plaintive, and their grief seemed so sincere, that there were but few dry eyes among the white bystanders who had come to see the last of old Joe Potoke. Before the company of mourners left the ground everything belonging to Joe was brought out from the house and broken up. Dishes, cooking utensils, knives and forks, buckets, and furniture sharing the same fate.—*Lower Lake* (*Cal.*) *Bulletin.*

ANTHROPOLOGICAL NEWS.—The second number of the *American Antiquarian*, edited by the Rev. S. D. Peet, contains the following articles: A Comparison of the Pueblo pottery with Egyptian and Greek ceramics, by Edwin A. Barber; Traditions of the Deluge among the tribes of the Northwest, by Rev. M. Eells; Description of an Engraved Stone by John E. Sylvester, M.D.; Prehistoric Ruins in Missouri; Gleanings, by S. S. Haldeman; Sketch of the Klamath Language, by Albert S. Gatschet; The location of the Indian tribes of the Northwest territory, by Stephen D. Peet; Remarkable Relics—Leaf Shaped Implements, by Prof. M. C. Reid. The paper of Mr. Barber is profusely illustrated, and shows considerable reading, but surely no one acquainted with the evolution of the art idea on our continent supposes that the Egyptians had anything whatever to do with it. With reference to Mr. Eells paper, and all ethnic stories of the same class, we shall have to lay down this canon, "As to matters of fact tradition is a tolerable guide to truth, while regarding matters of opinion it has no value whatever." The engraved stones, or tablets, seem to be the tender point with our western brethren. Dr. Sylvester's papers, backed up with affidavits, looks like the report of a Congressional committee. There is no doubt that much less temper would have been evoked by these objects if some of their admirers had not insisted on seeing in their rude lines symbols of something which never entered into the minds of those who manufactured them. Dr. Haldeman's gleanings consist of short notes on arrow-heads, tomahawks of honor, blunt arrow-heads, knives of cane, shaving, caves, charcoal, funerals, etc. The sketch of the Klamath language is by a master hand. The location of the Indian tribes by the editor is a contribution to a most important work. The author of these notes is gathering from every source, under the patronage of Major J. W. Powell of the Geographical Survey, materials for a classical dictionary of all the North American tribes. The information sought is the tribal

names in all their forms, both autonymous and heteronymous, their linguistic affinities, the original location and the migrations, the etymology of the names, and the chief authorities. Judge Henderson, of Winchester, Ill., read a paper before the American Association at St. Louis on the same subject. The notes are by Prof. E. A. Barber.

In noticing the Eleventh Annual Report of the Peabody Museum in the November number of the NATURALIST, sufficient emphasis was not given to the fact that Prof. Putnam claims to have discovered in the earthwork on the Lindsley estate, a map of which accompanies his paper, the vestiges of an ancient settlement. The work was a fortified camp, the large mound the site of some large edifice, the small circular banks the vestiges of houses, and the burial mounds the cemeteries of the dead.

It gives us great pleasure to record that the paper of Col. Garrick Mallery, read before the Nashville meeting of the American Association is attracting the attention which it deserves. The author was detailed, some two years ago, to work upon Indian matters in the office of Major J. W. Powell, geologist in charge of the U. S. Geographical and Geological Survey of the Rocky Mountain region. His previous training in literary matters had qualified him for the duties of a historical critic, and hence his research into the early aboriginal history of America led him to the conclusion that the former population had been greatly overestimated. Favorable notice has been taken of Col. Mallery's work in the British Association and in the Royal Society of London. Indeed, the question was seriously raised whether the conduct of the government in controlling its aboriginal population had not been too much influenced by the "melting away" doctrine.

The Rev. M. Eells has published at Portland, Oregon, a small book of hymns in the Chenook jargon language. It cannot be too strongly impressed upon those who have the opportunity that we cannot have too much of this linguistic material. Thomas Jefferson in his "Notes on Virginia," p. 193, wrote: "It is to be lamented then, very much to be lamented, that we have suffered so many of the Indian tribes already to extinguish, without our having previously collected and deposited in the records of literature the general rudiments at least of the languages they spoke."

In the October number of the *American Journal of Science and Arts*, Mr. W. J. McGee has a paper on the Artificial Mounds of Northeastern Iowa, and the evidence of the employment of a unit of measure in their erection. The author's profession has furnished him with abundant opportunities of measuring mounds, and he seems to have made good use of them. It was long ago supposed that a common standard had been employed by those who erected the earthworks of Ohio.

The Western Reserve and Northern Ohio Historical Society publishes, in No. 42, a paper by Col. Charles Whittlesey, entitled "Rock Inscriptions in the United States—Ancient Alphabets of Asia."

In Vol. i, Part 1, of Proceedings of the Central Ohio Scientific Association, of Urbana, Ohio, we have another evidence of the growing interest in science which manifests itself in our Western States. The principal contribution is a Report of the Antiquities of Mad River valley, by Prof. Thos. F. Moses, Urbana University, accompanied by eight plates of illustrations. Another valuable contribution to the archæology of Ohio which has hitherto escaped our notice, is the Final Report of the Ohio State Board of Centennial Managers, published in Columbus in 1877.

The following alphabet was prepared by Prof. Wm. D. Whitney to aid collectors in transliterating Indian vocabularies. The almost hopeless confusion in which the material already gathered is involved, is a sufficient motive for all writers on Indian linguistics to adopt it at once, or at least to show cause why they should not. The columns of this department are open to criticisms upon the subject:

a or *ā*,	long as in *far, father*, Gm. *haben*.
a or *ă*,	short as in Gm. *man*, Fr. *pas*; nearly as in (Eng.) *what, not*.
ą̄,	as in *hat, man*.
ą̂,	as in *law, far, all*.
ă^{n},	as Fr. *en* in *en, quand*.
ā^{n},	as Fr. *in* in *vin, rien, sein*.
ą̂^{n},	as Fr. *on* in *on, son, rond*.
ai,	as in *aisle*, Gm. *mein*; *i* in (Eng.) *pine, find*.
ą̂i,	as *oi* or *oy* in *oil, boy*.
au,	as *ou* or *ow* in *out, how*, Gm. *haus*.
b,	as in *blab*, Gm. *beben*, Fr. *belle*.
b',	nearly as *bh* in *cobhouse*.
bh,	as Gm. *w* in *schwer, zwei*.
c (or *ch*),	as *ch* in *church*, It. *cielo*.
d,	as in *dread*, Gm. *das*, Fr. *de*.
d',	nearly as *dh* in *madhouse*.
dh,	as *th* in *then, with*.
e or *ē*,	long as in *they*, Gm. *beet*.
e or *ĕ*,	short as in *then*, Gm. *belt*, Fr. *sienne*.
f,	as in *fife*, Gm. *feuer*, Fr. *feu*.
g,	as in *gig*, Gm. *gross*, Fr. *gros*.
g',	nearly as *gh* in *loghouse*.
gh,	[nearly as Arab. *ghain*.]
h,	as in *ha, he, hoot*, etc., Gm. *haben*.
h',	stronger aspiration.
hw,	as *wh* in *when*.
hy,	as in *hue*.
i or *ī*,	long as in *pique*, Gm. *ihn*, Fr. *île*.
i or *ĭ*,	short as in Gm. *will*, Fr. *ici*; nearly as in (Eng.) *pick, thin*.
j,	as in *judge*.
k,	as in *kick*, Gm. *kamm*, Fr. *quand*.
k',	nearly as *kh* in *inkhorn*.
kh,	as Gm. *ch* in *ich, milch, kirche*.
l,	as in *lull*, Gm. *lallen*, Fr. *lilie*.
ly,	as It. *gl* in *moglie*, (old) French *briller*.
m,	as in *mum*, Gm. *memme*, Fr. *me*.

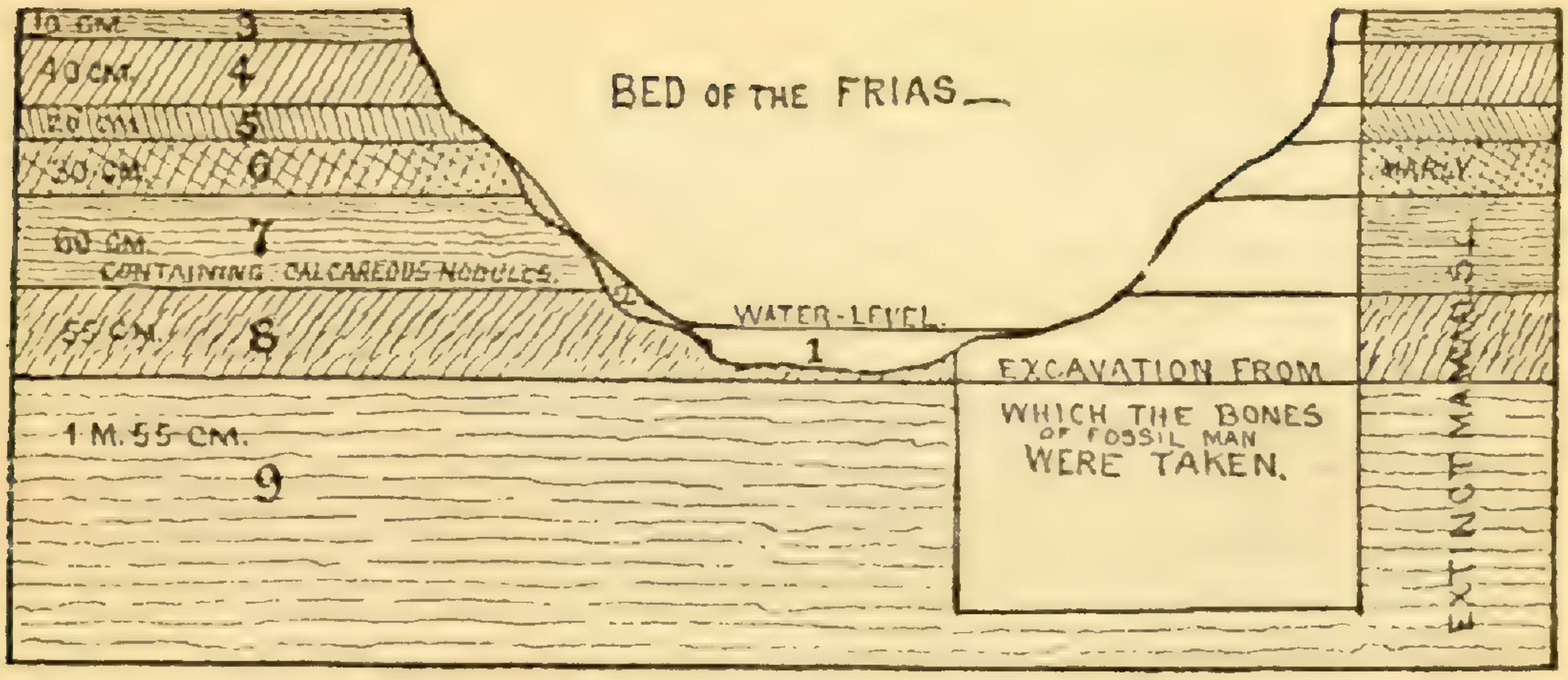
n,	as in *nun*, Gm. *nonne*, Fr. *ne*.
ñ,	as *ng* in *singing*, Gm. *singen*.
ny,	as Sp. *ñ* in *cañon*, Fr. *gn* in *règne*.
o or *ō*,	long as in *note*.
o or *ŏ*,	short as in (N. E.) *home*, Gm. *soll*, Fr. *mot*.
p,	as in *pipe*, Gm. *puppe*, Fr. *poupe*.
p^{t},	nearly as *ph* in *topheavy*.
ph,	as Gm. *f* in *pfeil*.
qh,	as Gm. *ch* in *ach*, *doch*, Scottish *loch*, Sp. *j* in *hijo*.
r,	as in *roaring*, Gm. *rühren*, Fr. *rare*.
rh,	uvular *r*.
s,	as in *sauce*, Fr. *sauce*, Gm. *wissen*.
sh,	as in *shun*, Gm. *schon*, Fr. *chair*.
t,	as in *trot*, Gm. *treten*, Fr. *tâter*.
t^{h},	nearly as *th* in *masthead*.
th,	as in *thin*, *truth*.
u or *ū*,	long as in *rule*, *fool*, Gm. *du*, Fr. *doux*.
u or *ŭ*,	short as in *pull*, *soon*, Gm. *null*, Fr. *nulle*.
û	as in *but*, *run*, *son*, *blood*.
û$_{n}$,	as Fr. *un* in *un*, *brun*.
ü,	as in Gm. *kühl*, *küssen*, Fr. *plume*.
v,	as in *valve*, Gm. *wenn*, Fr. *veux*.
w,	as in *wish*, *will*, *wayward*, nearly as Fr. *oui*.
y,	as in *you*, *year*, Gm. *j* in *ja*.
yu,	as *u* in *use*, *pure*, *mew*, *feud*.
z,	as in *zones*, Gm. *hase*, Fr. *zèle*, *rose*.
zh,	as in *azure*, *s* in *pleasure*, *fusion*, Fr. *juger*.

Foreign.—The October number of the *Revue d'Anthropologie* of Paris, contains the following communications: Note sur un tumulus préhistorique de Buenos Ayres, par M. Estasnilas Ceballos; Etude sur les Soninkés (Sénégal), par le Dr. Bérenger-Féraud; Le crâne des noirs de l'Inde (Tribu des Maravars) par M. E. Callamand; Notes sur les Bahnars (Cochin chine), par le Dr. A. Morice. Among the valuable reviews is the following in connection with the great Exposition: Congrès international des sciences anthropologiques, séance d'ouverture; Discours d'ouverture du Président, M. Paul Broca; Rapport sur les Societés d'anthroplogie, par M. Thulié; Rapport sur l'anthropologie générale, par M. P. Topinard; Rapport sur l'ethnologie, par MM. Girard de Rialle et Bordier; Rapport sur le Préhistorique, par MM. G. de Mortillet, E. Cartailhac, et E. Chantre; Rapport sur le Démographie, par M. Chervin.

GEOLOGY AND PALÆONTOLOGY.

The Man of the Pampean Formation.—The accompanying cut, for which, with the accompanying notes, we are indebted to Prof. Ameghino, of Mercedes, Buenos Ayres, exhibits a transverse section of the stream Frias, demonstrating the geological constitution of the strata at the point where the fossil man of Mercedes was found, together with a plan of the excavation made in exhuming the remains.

The Frias flows through a horizontal plain of uniform geological structure; its depth is from 2 m. to 2.30 m., its bed being scooped out of the pampean strata. Number 1 indicates the



water-level; 2, is a thin layer of gravel as found in excavating on the right side of the stream, and which was material deposited by the stream which it had washed from more elevated portions of its bed; number 3 is a layer of vegetable mold 10 cm. in thickness, which contains numerous bones of domestic animals introduced into the country since its occupation by Europeans; number 4 is a stratum 40 cm. in thickness, and contains the bones of animals indigenous to the country, and number 5 is a very clayey stratum 20 cm. in thickness, and contains the bones of extinct species of animals, but in a poor state of preservation; number 6 is a marly layer 30 cm. in thickness, in which the bones of the great extinct mammals, *Mylodon*, *Glyptodon*, etc., are found; number 7 is 60 cm. in thickness, is not nearly so marly as the preceding, and also contains remains of extinct animals; number 8 is 55 cm. in thickness, of a reddish color, and is composed exclusively of fine sand and clay mixed together. The stratum, number 9, which is more than 1.5 m. in thickness, is only distinguished from the preceding in that it contains a larger proportion of clay. In this layer of pampean soil, at the base of the excavation indicated in the diagram, and at a lower level than the bed of the stream, there were human bones discovered, together with rudely-shaped flints, apparently used in extracting the marrow from bones, a perforated femur of *Eutatus*, bones with incised and some with radiate markings and striæ, fragments of burnt bones, fragments of burnt or baked earth and a great quantity of charred vegetable substances. In the same deposit, mingled with the objects mentioned, there were also a great many bones of animals found, which indicated the following species:

1. *Hoplophorus ornatus* (Owen). A great part of the carapace and some bones.

2. *Hoplophorus* sp. indet. A portion of the carapace and other bones.

3. Skull and a large portion of the skeleton of *Eutatus* of a new species.

4. Portion of the carapace and bones of a very small armadillo of an undetermined species.

5. The skeleton of *Canis protalopex* (Lund).

6. Bones of many individuals of *Lagostomus angustidens* Burmeister.

7. Some bones of an undetermined species of horse.

8. Teeth and bones of *Cervus pampæus* Bravard.

9 and 10. Bones of many rodents of the genera *Reithrodon* and *Hesperomys*.

11. A species of *Dolichotis*.

12. Bones of a carnivore, which Prof. Gervais thinks appertain to a young *Machairodus*.

13. An ostrich [*? Rhea*] and many other bones belonging to undetermined species.

THE THEROMORPHOUS REPTILIA.—A paper on this subject was read by Prof. Cope before the National Academy of Sciences at its recent meeting in New York, on November 7, 1878. He stated that he had determined that the scapular arch in the *Pelycosauria*[1] consists of scapula, coracoid and epicoracoid, which form a continuum in the adult, in the same way as the three elements of the pelvis in the same group form an os innominatum. He showed that the tibiale and centrale of the tarsus unite to form an astragalus, which has no movement on the tibia. The fibulare forms a calcaneum. The distal side of the astragalus presents two faces, one of which receives a large part of the proximal extremity of the cuboid.

The structure of the scapular and pelvic arches was stated to be identical with that already described by Owen as belonging to the *Anomodontia*. Several important characters distinguish this group from the *Pelycosauria*, but the two together form an order which Prof. Cope thought would have, for the present at least, to be retained as distinct from the *Rhynchocephalia*. The characters of this order, with its two sub-orders were given as follows:

THEROMORPHA Cope. Scapular arch consisting at least of scapula, coracoid and epicoracoid, which are closely united. Pelvic arch consisting of the usual three elements, which are united throughout, closing the obturator foramen and acetabulum. Limbs with the phalanges as in the ambulatory types. Quadrate bone proximally united by suture with the adjacent elements. No quadratojugal arch.

Pelycosauria. Two or three sacral vertebræ; centra notochordal; intercentra usually present. Dentition full.

Anomodontia. Four or five sacral vertebræ; centra not notochordal; no intercentra. Dentition very imperfect or wanting.

The *Rhynchocephalia* have no distal ischio-pubic symphysis, and apparently no epicoracoid bone. They have an obturator foramen, and a quadratojugal arch.

The order *Theromorpha* was regarded by Prof. Cope as approximating the *Mammalia* more closely than any other division of

[1] See Proceed. Amer. Philos. Soc., 1878, p. 511 and 528.

Reptilia, and as probably the ancestral group from which the latter were derived. This approximation is seen in the scapular arch and humerus, which nearly resemble those of the *Monotremata*, especially *Echidna;* and in the pelvic arch, which Owen has shown in the *Anomodontia* to resemble that of the Mammals, and as Prof. Cope pointed out, especially that of *Echidna*. The tarsus is also more mammalian than in any other division of reptiles. In the genus *Dimetrodon* the coracoid is smaller than the epicoracoid, as in Monotremes. The pubis has the foramen for the internal femoral artery.

The discovery of the *Pelycosauria* established the important fact that the first land Vertebrata possessed a *chorda dorsalis*.

A species of *Dimetrodon* was described under the name of *D. cruciger*. It is characterized by the enormous length of the neural spines of the lumbar vertebræ, which form the dorsal fin seen in other species of the genus. They are found in masses adhering together like sticks or branches of bushes. In this species the spine sends off, a short distance above the neural canal, a pair of opposite short branches, forming a cross. At various more elevated positions there are given off tuberosities which alternate with each other. They form on several consecutive spines oblique rows. The spines are broadly oval in section, the long axis antero-posterior, and have a shallow groove on both the anterior and posterior aspects. The centra are elongate as compared with their other diameters, and are much compressed between the articular extremities, leaving a strong inferior median obtuse rib. Articular faces of zygapophyses oblique. Diapophyses short and robust, with large costal faces, and standing below the prezygapophyses.

MEASUREMENTS.	M.
Diameter of centrum { antero-posterior	.043
vertical at end	.028
transverse at end }	.030
Elevation of posterior zygapophyses above centrum	.025
" " cruciform process " "	.058
Expanse of posterior zygapophyses	.034
" " cruciform process	.048
Diameter of spine at base { antero-posterior	.030
transver-e }	.020
" " " .090 above base { antero-posterior	.016
transverse }	.016
Length of several pieces of neural spines	.140

DISCOVERY OF RECENT GLACIERS IN WYOMING.—It was not known until during the past season that genuine glaciers existed within the limits of the United States, east of the Pacific coast, but last summer as two of the divisions of the Geological Survey under my charge were exploring the Wind River mountains in Wyoming Territory, we found living glaciers on the east side of the range. On the east base of the Wind River peak, which is at the south end of the range, there is a mass of snow and ice, 900 yards long and

500 wide, with all the elements of a true glacier. On the east base of Fremont's peak, which is over 14,000 feet high, we discovered two glaciers, one of which covers an area of one and one-fourth square miles, and the other three-fourths of a square mile. They were marked by enormous crevasses; also with lateral and terminal moraines. We called them Upper and Lower Fremont glaciers. These would appear to be only insignificant remnants of the vast glaciers that must have covered these mountains during the true glacial period. On the west side of the range, the moraines and glaciated rocks are found on a vast scale. On the west side of the range, a glacier must formerly have existed, eighty miles long and twelve wide, with the arms extending up the gorges of the streams to the very water divide. These glaciers will be more fully described in the 12th Annual Report of the U. S. Geological Survey.—*F. V. Hayden.*

WASATCH GROUP.—Along the east side of the Wind River mountains and filling up the Upper Wind River valley, is a great thickness of modern Tertiary strata that has been weathered into very remarkable forms, and which are known in the West as "Bad Lands." The strata are most beautifully variegated with various shades of pink or brick-red color, so that they sometimes remind one of the Jura-Trias red beds. This formation was described by me in 1859, in detail, and named the Wind River group. It covers a broad area in this region, extending from the source of Wind river to the Sweet Water mountains, south more than one hundred miles, and west an average width of one to five miles. The aggregate thickness of this group cannot be less than 5,000 feet. On the west side of the Wind River mountain, no formations older than the Wasatch group are found. This group rests, doubtless, on the Archæan nucleus, inclining at the base five to ten degrees. All the older sedimentary rocks have been entirely swept away from the granites for a distance of one hundred miles, while on the opposite or east side all the corresponding strata are visible from the Silurian to the Cretaceous; the Wasatch beds cover a large part of the Green River Valley, especially about its sources.

I am convinced, also, that a group of strata which I named in 1869, Gallisteo Sand group, in the valley of Gallisteo creek, a branch of the Rio Grande, is also the equivalent of the Wasatch group,[1] though both Wind river and Gallisteo Sand group as names have the priority over Wasatch, yet the latter has been now so much used in the Reports on Western geology, that it will probably prevent the use of the former to any extent in the future. When the Northwest is more fully explored, it will probably be found that the Wasatch group covers a large area extending more or less from our north line far into New Mexico.—*F. V. Hayden.*

[1] See Annual Report, page 177, reprint.

THE DEVONIAN AND SILURIAN FORMATIONS OF BRITTANY.—Dr. Chas. Barrois, of Lille, has published in the annals of the Geological Society of the North, for 1877, an account of his investigations into the geology of Brittany. He finds in the Devonian formation of that region, five well-defined horizons, some of which had been previously unknown in France. He discovered certain previously unsuspected relations between the formation, and that of the valley of the Lahn. At the Rode of Brest but three of these horizons are present, the second, third, and fifth. As regards the Silurian, Dr. Barrois finds the same horizons in Brittany that have been observed in other basins of the same formation. He, however, makes a number of rectifications of previous descriptions of the geology of Finistère.

THE GEOLOGY OF BELGIUM.—Much activity exists among the geologists of Belgium, and numerous articles have recently appeared, which advance the science in that country. The magnificent work of M. Van Beneden on the extinct Cetacea of the neighborhood of Antwerp, has reached the second part. M. Rutot has recently published an account of the fossils of the inferior Oligocene, and M. G. Vincent, the history of the Fauna of the Landenien inferieur. M. Rutot determines that the *Nipadites* and other fossil plants found in the neighborhood of Brussels, are derived from the Bruxellien, and not from the Lackenim as has been supposed. M. Lefèvre has discovered tortoises and *Halitherium* in the same region.

THE SOUTHERN BOUNDARY OF THE GLACIAL DRIFT.—In his Report as State Geologist of New Jersey, for 1877, Professor George H. Cook, presents some important facts relative to the southern limit of the glacial drift in that State. He finds it in a series of hills which cross the mouth of the Hudson river at the Narrows, and Staten Island Sound at Perth Amboy, which then extend northwards to near Morristown and Dover, and then westwards, crossing the Delaware river at Belvidere. These hills are composed of gravel, sand, boulders and stones commingled in a confused mass, and are identical in character with the material that fills the valleys to the north of them. The parent rock is in every case to the north, sometimes at a distance of twenty to thirty miles.

Professor Chamberlin, State Geologist of Wisconsin, presented to the Congress of Geologists recently held in Paris, a paper on the terminal moraine of the Great Lake District. Advance copies of the paper were printed in Paris. In this paper Professor Chamberlin describes an extensive belt of drift hills and ridges which traverse the quarternary deposits forming immense loops about the southern boundaries of the Great Lakes for a distance of 2000 miles in length, and a width of from one to thirty miles. Portions of this ridge had been observed by Lapham, Whittlesey, Andrews, and others. The material of the range consists of un-

stratified débris of all formations adjacent northwards, with some stratification of the surface of an irregular kind. A peculiar feature of the range is the presence of large holes and sinks, some of which are full of water. From these holes the range is called the Kettle Moraine. Its distribution is alike regardless of the geological and topographical features of the country, excepting in its parallelism to the southern border of the Great Lakes. Professor Chamberlin regards it as a terminal moraine which marks a period in the history of the glaciers which are supposed to have once filled the depressions now occupied by the Great Lakes.

MIOCENE VERTEBRATA OF OREGON.—An examination of a collection of vertebrate fossils from the John Day river, Oregon, recently made by Prof. Cope, yielded the following species: Artiodactyla—*Hypertragulus calcaratus* Cope, *Leptomeryx evansi* Leidy, *Eucrotaphus superbus* Leidy, *E. occidentalis* Marsh, *Merycochœrus leidyanus* Bettany, *Hyopotamus guyotianus* sp. nov., *Thinolyus socialis* Marsh, *T. lentus* Marsh, *Elotherium imperator* Leidy. Perissodactyla—*Rhinocerus pacificus* Leidy, *Anchitherium equiceps* sp, nov., *A. brachylophum* sp. nov., *A. longicristis* sp. nov., *Dæodon shoshonensis* gen. et sp. nov. (allied to *Chalicotherium*). Carnivora—*Canis gregarius* Cope, *C. lippincottianus* Cope, *C. cuspigerus* sp. nov., *C. geismarianus* sp. nov., *Temnocyon altigenis* gen. et sp. nov., *Machærodus strigidens* sp. nov, *M. brachyops* sp. nov. Rodentia—*Meniscomys hippodus* gen. et. sp. nov., *M. multiplicatus* sp. nov., *Pleurolcus sulcifrons* gen. et sp. nov., *Entoptychus cavifrons* gen. et sp. nov., *E. planifrons* sp. nov., *E. crassiramis* sp. nov., *Steneofiber* sp., *Stenofiber gradatus* sp. nov., *Palæolagus haydeni* Leidy.—*Proceedings of the Amer. Philosophical Society.*

GEOGRAPHY AND TRAVELS.[1]

THE AMAZON.—In the September number of the NATURALIST mention was made of the survey of the Amazon and Madeira rivers, undertaken by the U. S. corvette *Enterprise*, Commander Selfridge. This vessel arrived at New York on the 25th of September last, and we learn from the New York *Herald* of the successful accomplishment of her mission. At Serpa, near the mouth of the Madeira they found the Amazon a mile in width and sixty feet deep. The Madeira is here about two miles wide, and its principal channel has a depth of from ninety to sixty feet, according to the season of the year. From near its mouth to the falls its banks are high and well marked. The steamer entered the Madeira on the 17th of June, and advanced without difficulty at the rate of twenty-five miles a day, stopping at night, until the 21st, when near the island of Araras the pilots reported rocks and shoals. Although careful investigation proved that no rocks were there, and five fathoms of water was found, it was not deemed advisable for the ship to cross, owing to the reports of

[1] Edited by ELLIS H. YARNALL, Philadelphia.

the pilots and natives of the great and sudden changes in the rise and fall of the stream. The survey was, however, continued by the steam launch to San Antonio, a distance of about 325 miles, with the exception of the last thirty miles, which was, owing to an accident to the launch, made by Capt. Selfridge and Lieut. Perkins on board a Brazilian merchant steamer. Leaving the *Enterprise* on the 25th of June, the surveying party were again safe on board on the 20th of July. The results of their observations show that a navigable channel for ships drawing up to sixteen feet of water exists from the mouth of the Madeira to San Antonio, a distance of 500 miles. This channel is passable during nine months of the year, but during the time of low water, namely, August, September and October, the river is so low that in many places not more than six or eight feet can be carried. The adjacent territory is very thinly populated. Large quantities of rubber are collected and shipped along the river, and also copaiba, sarsaparilla, copal and chouta, a black odoriferous gum used as a cement.

ARCTIC EXPLORATION.—The schooner *Florence*, Capt. Tyson, which was fitted out and sent by Capt. Howgate to Cumberland Gulf to procure skins, dogs, sledges and other material for the use of his expedition, has returned home, and from a dispatch by Capt. Tyson to the New York *Herald*, we learn that he sailed from New London on the 2d of August, 1877, and reached the Gulf after a tedious voyage of forty-one days. Here they remained in Niantilic harbor, latitude 65° 10′ north, longitude 67° 30′ west, until October 1st, when they removed to Annatook harbor, at the head of the Gulf. There they passed the winter and spring. On the 19th of July they sailed for Disco island, taking with them fifteen Esquimaux, men, women and children, twenty-eight dogs, a fair quantity of skin clothing and a great many skins. Arriving at Disco on July 31st, they remained until August 22d, when no intelligence of the expedition being received, they returned, after a difficult passage through the ice off Cape Mercy, to the Gulf. After discharging the Esquimaux they started on their voyage home on the 2d of September. Messrs. Kumlin and Sherman, the scientific members of the party, were very successful in the performance of their duties. The former has secured a large number of specimens, and the latter, aided by two of the crew, took hourly observations during the winter. The season has been a bad one. Melville Bay has been entirely blockaded by the ice, no whalers having been able to penetrate it, and the Danish ships have been unable to reach the upper settlements.

RESULTS OF THE RECENT BRITISH ARCTIC EXPEDITION.—Sir George Nares has, in his "Narrative of a Voyage to the Polar Sea," recently published, given more fully his reasons why he

believes it is impracticable to reach the Pole by the Smith Sound route. The heavy polar pack, formed of ice from 80 to 100 feet in thickness, is rendered almost impassable by dense hummocks from 20 to 40 feet in height, or floes of most uneven surface covered with deep snow. North from Cape Joseph Henry, in latitude 83°, no land exists as far as the 84th degree, and he believes there is none for a distance of 200 miles.

Whether or not land exists within the three hundred and sixty miles which stretch from this limit to the northern axis of the globe is, so far as sledge traveling is concerned, immaterial. Sixty miles of such pack, Capt. Nares holds to be an insuperable objection to traveling in that direction with our present appliances.

The Polar sea extends along the northern coast of Grinnell land westward for a distance of at least two hundred miles, when the coast trends to the south-west, and no land further north is accessible by a sledge expedition in that direction. Entrance to all bays or harbors westward of Cape Joseph Henry is also barred by the Polar ice-wall. A similar barrier of ice exists along the North Greenland coast, so that no ship can hope to find protection on either of these shores.

Capt. Nares also regards the similarity in the character of the ice, and the formation of the coast of Banks land and Prince Patrick's island, to that of Grinnell land as evidence that the Polar sea extends to their shores, but the reverse conditions existing on the northern shore of the Parry islands indicates the extension of Grinnell land more or less continuously for the whole distance to Ireland's Eye, protecting the Parry islands from the Polar ice. It is, however, probable that Jones' sound affords the most direct route from Baffin's bay in a north-westerly direction to the Polar sea, separating Grinnell land from the land which protects the Parry islands.

From the "Abstract of Tidal Observations," by Dr. Samuel Haughton, we learn that the new tidal wave observed on board both the *Alert* and *Discovery* is *specifically* distinct from the Baffin's bay tide, and from the tide that enters the Arctic ocean through Behring's straits; and it is, without question, a tide that has passed from the Atlantic ocean round Greenland northwards and then westwards. Greenland probably ends not far north of latitude 82° or 83°.

Geographical News.—The deep sea soundings taken on board the U. S. Coast Survey steamer *Blake* during her voyage in the Gulf of Mexico, mentioned in our September number, were made about the south-east of the Gulf, about the Florida bank, west of the peninsula of the same name, about the Yucatan bank, and north-west of that peninsula and in the intervening portion of sea between the above-mentioned places and the western end of the island of Cuba. Prof. Alexander Agassiz who conducted these

investigations obtained surprisingly rich zoölogical results. The deepest sounding was taken between the Tortugas and the northeast cape of Yucatan (Cape Catoche) and was 1,920 fathoms; the next deepest being 1,568, north of the same. All depths of water of about 600 fathoms and upwards gave a uniform temperature of 39.5° Fahrenheit.

A correspondent of the New York *Tribune* gives an account of the results of a recent careful survey of Newfoundland under the superintendence of a Geological Commission. The area of the island is now found to be 42,000 square miles. It is 317 miles in length and 316 miles in breadth. It is, therefore, the tenth largest island in the world, and contains 10,000 square miles more than Ireland. Nor is there to be found an equal area with such an extent of coast line as Newfoundland, which, according to the Surveyor's report, cannot be less than 2,000 miles in length.

Prof. F. V. Hayden, in charge of the U. S. Geological Survey of the Territories, has recently been elected foreign member of the Royal Academy of Sciences, Letters and Arts, of Palermo, Sicily.

The English Palestine Exploration Fund has successfully accomplished the survey they began, in 1872, of all Palestine west of the Jordan. The scientific results of this survey are to be made public in a series of memoirs. The map is to be on the scale of one inch to a mile. The portion east of the river was assigned to the American Expedition, and is not yet completed.

MICROSCOPY.[1]

National Microscopical Congress (*Continued*).—Dr. R. H. Ward spoke at some length in regard to "Recent Progress in Microscopic Ruling," referring chiefly to the recent work of Mr. Charles Fasoldt, of Albany, and of Professor Wm. A. Rogers, of Cambridge. Mr. Fasoldt's experiments in ruling commenced during the middle of last winter, and must be regarded as remarkable considering the fact that he was entirely unfamiliar with the microscope and its use, and knew nothing of what had been done or could be done in microscopic ruling. Being a manufacturer of chronometers, he possessed the advantage of great skill in small mechanical operations and some experience in handling gems. He first, at the casual suggestion of a friend, undertook to make circular rulings, described with a common lathe and spaced with the slide-rest; and in this manner produced fair concentric circles as close as $\frac{1}{50000}$ of an inch. Parallel straight lines of equal closeness, but not of equal excellence, were then made on the same lathe, both the spacing and the ruling being accomplished by the motions of the slide-rest. Dissatisfied with this result, a screw machine was extemporized, and much closer lines of much better quality were produced. Some of the bands ruled with this little screw were better than many of the commercial

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

micrometers, though not to be compared with the work of Nobert or of Rogers. The screw was then abandoned, and the machine prepared with which the present work is done. Unfortunately, the maker is unwilling to give further information about this machine than that it has other than a screw motion, intimating, perhaps, that the spacing is accomplished by a lever movement. The finest bands are ostensibly ruled to $\frac{1}{120000}$ inch,[1] but it may be considered doubtful whether they are ruled according to the reading of the machine that made them. The bands up to $\frac{1}{60000}$ inch have been reported correct by authority that ought to be competent to judge, and the whole series is worthy of careful study by those who are expert in such work. Of a very different class is the progress made by Professor Rogers during the past year. The stage micrometers hitherto used as a basis of micrometry have scarcely claimed to possess a definite degree of accuracy. The speaker had used for years a standard obtained by comparing about two hundred micrometers ruled in different parts of the world, rejecting the few that from their wide deviation from the average were presumably erroneous, and averaging the remainder. Probably such a standard, though unsatisfactory, because of uncertain value, was as nearly safe as anything heretofore attainable. To obviate this uncertainty, Professor Rogers determined to derive a standard inch, with a precision not known to have been obtained before, from "Bronze bar No. 11," which has been the authorized standard in this country since 1855, having been presented to the United States by the British Government as one of the five original duplicates of "Bronze 19" the only English standard since the "standard yard of 1760" was destroyed by fire, and to derive a standard centimetre from the iron bar now in possession of the United States Coast Survey, one of the original standard metres, and the best representative in this country of the platinum metre deposited in the Archives of Paris. He fitted a glass bar forty-two inches long, one inch wide and one and a quarter inches thick, into an iron frame, the surfaces being made as true a plane as possible. With a diamond in a graduating engine he laid off upon it one hundred centimetre divisions. He then took the bar to Washington where the said lines were compared with the standard metre, and where the British yard and the Archives metre were transferred from the Saxton comparator of the United States Coast Survey to both the glass bar and its iron frame. The errors of the subdivisions of the yard, and of the metre, were investigated by means of a comparator constructed for the purpose of subdividing any unit into equal parts. The corrections for each subdivision having been determined, a number

[1] Mr. Fasoldt's finest lines are now made in twelve-band plates, the lines of the lowest band being 1–10,000 of an inch apart, of the next band 1–20,000 inch, of the next 1–30,000, and so on, increasing 10,000 to the inch each time to the twelfth band, which, if successfully ruled, has lines spaced to 1–120,000 inch. These plates can be made at as low a price as $15.00.

of copies of that division as corrected are ruled, and the one selected which corresponds most nearly with the computed correction. A similar process is applied to each subdivision, and finally these subdivisions are compared among themselves, and the one selected which is nearest the mean of the whole number. Thus the $\frac{1}{36}$ of a standard yard, and the $\frac{1}{100}$ of a standard metre, have been obtained with a certainty not believed to have been secured before. The standard centimetre thus produced by Prof. Rogers was submitted to the Congress for the use of members who might desire to determine the value of the divisions of their micrometers in terms of the Coast Survey standard.

Prof. J. D. Hyatt, of New York, gave a very interesting address on "The Sting of the Honey-bee," illustrated by a large number of diagrams. His paper, with its illustrations, will be published in the forthcoming number of the new quarterly.

"On the Construction of Oculars," by Wm. H. Seaman, of Washington. The discrepancies in published statements in regard to oculars, led the author to make a full series of measurements of the parts of eighteen oculars by English and Continental makers, and to present the results in a tabular form. By inspecting the table it appears that the common ratio between the focal lengths of eye lens and field lens is $\frac{1}{2}$, in one instance it is $\frac{1}{3}$, and in one of older construction $\frac{7}{9}$. The only general principle in regard to the interval separating the lenses is, that it shall be less than the solar focus of the field lens; and when in the deeper oculars, and those which are orthoscopic, it seems to exceed this limit, it must be remembered that in connection with the objective the ocular receives diverging rays, and for such, its focus is beyond the solar focus. It may also be noticed that but a small part of the diameter of the eye lens is actually used in the lower powers.

Prof. J. E. Smith made some remarks on "Micrometer Rulings," repeating his claim, formerly published, as the first to have resolved Nobert's 19th band, by reflected light. He also expressed the belief that he had resolved by reflected though not by transmitted light bands of $\frac{1}{120000}$th inch ruled, or attempted to be ruled, by Rogers.

"A New Turn-table" was exhibited and described by John W. Sidle, of Philadelphia. This table is self-centering by the Cox method, having jaws that press diagonally toward the center of the slide. Instead of the screw movement of the original form, or the lever or scroll screw of later modifications, the jaws are mounted near the edges of two small circular discs which are set into the main plate or table, on opposite sides of the center, and which by revolving simultaneously change the distance of the jaws from the center of the table. The mechanism seemed unlikely to get out of order, and a very steady and prompt motion was attained.

Prof. William Lighton, of Ottumwa, Iowa, described a "New Arrangement for Dark-field Illumination," in which an effect comparable to that of a spot-lens was produced by placing above the eye-piece a diaphragm with an aperture of $\frac{1}{20}$ inch, decentered so as to cut off the central cone of light ordinarily used by the eye. This effect is produced most perfectly with an achromatic eye-piece. He also described "An Analyzing Eye-piece," containing a bundle of reflecting plates arranged at a polarizing angle.

Dr. R. H. Ward gave an account of recent improvements in "Biscoe's Section Cutter." The principles of construction of this machine, which is said to have been founded on some German inventions, were fully explained in the NATURALIST for Jan., 1874. As now made by Mr. L. Schrauer, of New York, it has a central cylinder and plunger like other section cutters. In this way the object to be cut is arranged with great facility, while the thickness of the sections is regulated with ease and precision by the screws that support the carriage. This arrangement has a capacity for easy and good work that is almost incredible to persons accustomed to use other contrivances.

A communication on "Seiler's Section Cutter," by Wm. H. Walmsley, was read by title in the absence of its author.

A paper on "Epithelium" was read by Dr. W. H. Atkinson, of New York.

After referring the question of publishing proceedings to the executive committee, and passing an appropriate vote of thanks for favors received at Indianapolis, the Society adjourned until the Buffalo meeting.

NEW FORMS OF MOUNTING.—The cement which is essential to these processes, and which I regard as the most important working material of the microscopist, is shellac varnish prepared in the following simple manner: The white purified gum shellac is dissolved in alcohol and filtered through cotton one or more times until it is quite clear and transparent. As the filtering is to most persons a somewhat difficult operation, they had better perhaps let the druggist make this preparation for them. With this cement I build up a cell as deep and perhaps as quickly as one can be made with a curtain ring, painted up as it usually is. As much as one or two drops can be put on a slide with a brush, using the turn-table, and then slowly worked up into a narrow ring with the point of a small knife-blade held on the turning slide. When this has dried a day or two, another layer can be put on and worked up in the same way. Three or four such layers will be sufficient for almost any cell, and it can then be dried in the heating oven and laid aside for future use.

By carrying along a dozen or two slides at once, one will find great economy both of time and labor. These rings being transparent are admirably adapted for opaque mountings, with which it is desired to use the Lieberkühn.

If common curtain rings are fastened to slides with shellac cement, colored with aniline blue, the joined edges of the brass film of which the ring is made being on the glass, and then subjected to a slowly increasing heat until the cement begins to burn, a very beautiful ornamentation is given to the under side of the ring, a circle of minute golden links making their appearance there. These rings can then be painted according to fancy on the turn-table and used for any kind of mounting.

I use this cement, colored with the various aniline dyes which are soluble in alcohol, for painting and finishing slides. These colors are far superior, for all purposes of ornamentation, to any other material or devices for painting; they dry quickly and adhere to glass with greater tenacity than any other cements that I have ever used.

For a cell that will perfectly withstand the action of Canada balsam or turpentine, I make use of the shellac cement colored with aniline blue, in the following manner: After a cell of the required depth is made on the slide and pretty thoroughly dried in the usual way, it is heated on the heating table, slightly at first in order to avoid bubbles, then gradually increasing the heat until the cement commences to smoke and the color to burn out. By heating one side of the ring a very little more than the other, as may be done over an alcohol lamp, a part may be left blue while the other is yellow or reddish, which has a very pretty effect under Canada balsam. These cells are hard as bone, and can scarcely be cut from the glass. Balsam has no effect whatever on them. Mountings on them may be finished off with liquid balsam, made true and circular with the point of a knife on the turn-table. In a few days, or in a shorter time by using the oven, they will be ready to clean and lay away. The cells which I have described are the only cement cells that can be used with Canada balsam. They are particularly adapted to vegetable stainings, algæ, and all other preparations either too thick or too tender to be mounted in balsam without something to sustain the thin glass covers.

In opaque mountings when cements of any kind are used, either for back-ground or to hold the object in place, I have found it highly advantageous to leave on, or in the lower part of the ring, a minute aperture opening into the cell, not necessarily larger than a cambric needle would make. With this provision both the cell and the cement go on drying, and there is no sinking in or moving about of the objects in the medium which holds them. If the cell be hermetically closed, one may expect that the object will, sooner or later, be overwhelmed in a black sea. If curtain rings are used, a little notch can be filed in the side of them, and this be left open when the slide is finished.

If the opaque mountings are for dry objects, I make in the center of the ring a disk of Brunswick black or white zinc, accord-

ing as the object to be shown is white or black. It may be $\frac{5}{16}$ of an inch in diameter for the Lieberkühn of the $1\frac{1}{2}$ inch objective, but not over $\frac{1}{4}$ inch for that of the $\frac{2}{3}$ objective. After the cement is dry and quite hard, a thin coat of balsam is spread over it and the objects placed in this and arranged if necessary under the microscope. The slide is then set aside to dry and may safely be covered the next day. If the object to be mounted will bear immersion in balsam, as some shells, seeds, minerals, etc., I pursue the following plan: The thin glass covers are cemented to some old slips, kept for the purpose, by two or three touches of the balsam applied to the edge of the cover, care being taken to center the cover on the slip by means of the self centering turn-table. The objects are then arranged on a light coating of balsam on the center of the cover. When quite dry they should be completely covered by balsam and thoroughly hardened in the drying oven. Then Brunswick black or white zinc may be spread over the object, in thin layers at first, each being dried in the open air for a day before putting on the next, until an opaque covering is made for the object. Thoroughly clean the cover around the objects and then remove it from the slip by a slight heating. Then turn it over and mount it upon the cell prepared for it. Fasten the cover to the cell with gelatine softened by water to the consistency of jelly and then liquified by alcohol. Put the cover on the cell and apply the gelatine solution with a brush around the edge, leaving the little opening before referred to. When dry the cell may be finished with liquid balsam, carefully avoiding the little aperture. The outer edge may be gathered up into a neat trim circle with the point of a knife on the turn-table. —*C. C. Merriman, Rochester, New York.* (*Read at the National Microscopical Congress at Indianapolis, August,* 1878.)

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SCIENTIFIC NEWS.

— British Association for the Advancement of Science. We conclude our account of the last meeting, which was, on the whole, one of the largest, most varied and pleasant that has been held for twenty years. Several of our American scientists read papers. Prof. T. Sterry Hunt made communications on the Metamorphic or Archæan rocks of America as compared with those of Great Britain, and also on the geological relations of the atmosphere. Prof. E. D. Cope read papers on the Sauri-ans of the Dakota formation of the Rocky mountains, and on the Vertebrata of the Permian formation of Texas. Mr. Graham Bell made a communication on the Telephone. Prof. Cook, State-geologist of New Jersey, was also present. Of the papers of special interest, we note one in the zoölogical section by Sir Victor Brooke on the deer; a good point he made was the existence of a constant variation in the horn of *Cervus dama*, which

originated in an old buck, and now characterizes the entire herd in one park in West Ireland.

In physiology a good paper was the one on the location of sounds in the head on application of tuning-forks, telephone, microphones, etc.

In zoölogy another good paper was by Dr. Traquair on the structure of *Ctenodus* and *Dipterus*, in which he showed that the head of the latter is covered with segmented scuta like the sturgeon; the author brought out many other important points.

In general it may be remarked that the conduct of the meetings of the Association is very similar to that of our own. The tendency to complimentary criticism was probably rather more largely developed, but this did not prevent the fullest expression of adverse opinions when such were entertained.

As a good example of one of the evening lectures we quote, in part from the Dublin *Irish Times*, an abstract of Mr. J. G. Romanes' lecture on "Animal Intelligence," which attracted special interest; he said: "We thus see animal instincts may arise in either of two different ways, on the one hand, they may arise from the performance of actions which were originally intelligent, but which by frequent repetition have become automatic; and on the other hand, they may arise from survival of the fittest, preserving actions, which, although never intelligent, happen to have been of benefit to the animals which first chanced to perform them. But now let it be observed that although there is a great difference between these two kinds of instincts if regarded psychologically, there is no difference between them if regarded physiologically; for, regarded physiologically, both kinds of instincts are merely expressions of the fact that particular nerve-cells and fibres have been set apart to perform their reflexes automatically—that is, without being accompanied by intelligence. In making these observations we are not necessarily committing ourselves to the doctrine of materialism. That physiological phenomena are intimately connected with natural phenomena does not admit of doubt, but concerning the nature of this association scientific men declare not merely that it is at present unknown, but that, so far as they are at present able to discern it must forever remain unknowable. The restless tide of intellect for centuries has onward rolled, submerging in its arms those rugged shores whose name is mind, but at the lines where mind and matter meet there arises a mighty history like a frowning cliff, and in the darkness of the place we hear the voice of true philosophy proclaim: 'Hitherto shalt thou come, but no further, and here shall thy proud wave be stayed.' So much then for what I have called the physiological basis of mind. Passing on now to our review of comparative psychology, the first animals in which so far as I can ascertain we may be quite sure that reflex action is accompanied by ideation, are the insects. Well, remembering this distinction,

we shall find that the only difference between animal intelligence and human intelligence consists in this—that animal intelligence is unable to elaborate that class of abstract ideas the formation of which depends on the faculty of speech. In other words, animals are quite as able to form abstract ideas as we are, if under abstract ideas we include general ideas of qualities which are so far simple as not to require to be fixed in our thoughts by names." The lecturer also proceeded to show that animals had reason and judgment. "Passing on to the emotional life of animals, we find that this is very slightly, if at all, developed in the lower orders, but remarkably well developed in the higher; that is to say, the emotions are vivid and easily excited, although they are shallow and evanescent. They thus differ from those of most civilized men in being more readily aroused and more impetuous while they last, though leaving behind them but little trace of their occurrence. As regards the particular emotions which occur among the higher animals, I can affirm from my own observations that all the following give unmistakable tokens of their presence: Fear, affection, passionateness, pugnacity, jealousy, sympathy, pride, reverence, emulation, shame, hate, curiosity, revenge, cruelty, emotion of the ludicrous and emotion of the beautiful. Now this list includes nearly all the human emotions, except those which refer to religion and to the perception of the sublime. These, of course, are necessarily absent in animals, because they depend upon ideas of too abstract a nature to be reached by the mind when unaided by the logic of signs. Time prevents me from here detailing any of my observations or experiments with regard to the emotional life of animals, so I will pass on at once to the faculty of conscience. In highly intelligent, highly sympathetic and tolerably well treated animals the germ of a moral sense becomes apparent. On the whole, therefore, I can only suppose that we have in these actions evidence of as high a development of the ethical faculty as is attainable by the logic of feelings when unassisted by the logic of signs; that is to say, a grade very nearly if not quite as high as that with which we meet in low savages, young children, many idiots and uneducated deaf mutes. In savages, as in animals, there was a remarkable tendency to act in accordance with performed habits rather than to strike out improved modes of action. Very young children present only those lower faculties of mind which in animals we call instincts. With advancing age, the first indication of true intelligence seems to consist in the power of forming special associations. On the general theory of evolution we should expect that in such a descending scale the characteristically human, or the more recently developed faculties should be the first to disappear, while those faculties which man shares with the lower animals should be the more persistent. And this expectation I have found to be fairly well realized. Beginning from

below, the first dawn of intelligence in the ascending scale of idiots, in the ascending scale of animals, is invariably to be found in the power of associating simple concrete ideas. Thus there are very few idiots so destitute of intelligence that the appearance of food does not arouse in their minds the idea of eating; and, as we ascend in the scale idiotic, we find the principle of association progressively extending its influence, so that the mind is able, not only to establish a greater and greater number of special associations, but also to retain these associations with an ever increasing power of memory. In the case of the higher idiots, as in the case of higher animals, it is surprising in how considerable a degree the faculty of special association is developed notwithstanding the dwarfed condition of all the higher faculties. On the whole then, from the mental condition of uneducated deaf mutes, we learn the important lesson that in the absence of language the mind of man is almost on a level with the mind of a brute in respect of its power of forming abstract ideas.

The Association will meet next year at Sheffield, under the presidency of Prof. Allman.

— THE CONGRESS OF GEOLOGISTS AT PARIS. The existence of this body is due, firstly, to the exertions of a committee which met in Philadelphia during the Exposition of 1876; and secondly, to the energetic coöperation of the Geological Society of France, which took in charge the arrangement of the details of the organization. The officers selected by this body and elected by the Congress on its opening, were the following: president, M. Hébert; vice-presidents, England, M. Davidson; Belgium, De-Koninck; Canada, Sterry Hunt; Denmark, Johnstrupp; Spain, Villanova; United States, Hall; France, Daubrée and Gaudry; Hungary, Szabo; Italy, Capellini; Holland, Von Baumhauer; Portugal, Ribeiro; Roumania, Stephanescu; Russia, De Moeller; Sweden, Thorell; Switzerland, Favre; general secretary, Jannetaz; secretaries, M. Brocchi, Delaire, Sauvage and Vélain; treasurer, M. Bioche.

The Congress assembled on Thursday, the 22d August, in the large hall above the commencement of the left wing of the Trocadero. To such of our readers as have not seen this building it may be interesting to remark, that it is situated on the side of a hill on the right side of the Seine, which slopes gently towards the bank of the river. It faces the main building of the Exposition which stands on the left bank, the two being connected by ornamental grounds, and by the bridge of Jèna. The building consists of a central portion of the form of a semicircle to which are added two long arm-like wings, which follow the direction of the circumference of a large circle for perhaps 120°. The convexity of the central building is inwards, and presents several porticoes, one above the other. From the summit of the lowest of these a wide sheet of water descends with a face con-

vex transversely, and is received into a basin. From this the water flows by a succession of falls to a large basin below, which is adorned with numerous fountains. At four points in its circumference are the gilded figures, of life size, of four prominent species of animals—the elephant, horse, ox and rhinoceros. On each side of the staircase of waterfalls is a series of small fountains composed of very many fine jets of little elevation, the whole producing the effect of tufted vegetation.

The hall of meeting is well adapted for the use of the Congress, which includes a membership of two hundred and fifty persons. The proceedings of the first day, August the 29th, opened with an election for officers, which resulted in the selection of the names above enumerated. An allocution from Prof. James Hall, of New York, president of the committee of Philadelphia, followed. The report of this committee succeeded, and the organization was completed by the announcement of the names of the officers elected.

The papers announced for the opening day were the following: 1. M. Daubrée, Etudes expérimentales sur les déformations et les cassures de l'écorce terrestre. 2. M. A. Favre, Sur les expériences relatives aux effets de refoulements latéraux en géologie. 3. M. De Chancourtois, Représentation et coordination des faits d'alignements (Failles et Filons). 4. M. De Lapparent, Les plissements de la craie entre la France et l'Angleterre à propos du chemin de fer sous-marin. 5. M. Gorceix, Sur les gisements aurifères et sur les pierres précieuses du Brésil.

The papers for the 30th of August were the following: 1. M. James Hall, On the Nomenclature of American palæozoic rocks and the construction of geological maps. 2. M. Stephanescu, Nomenclature géologique uniforme pour tous les pays en ce qui regarde les terrains et les étages. 3. M. Van den Broeck, Valeur des termes de l'échelle stratigraphique du globe. 4. M. Renevier, Rapport sur l'emploi des couleurs et des termes désignant les subdivisions des terrains. 5. M. Rutot, De l'adoption des subdivisions uniformes pour les terrains tertiaries. 6. M. De Chancourtois, Unification des conventions pour les cartes gélogiques. 7. M. Villanova, Bases d'un dictionnaire de géologie. 8. M. l'Abbé Almera, Réimpression des ouvrages de paléontologie.

On the 31st of August the following papers were read: 1. T. Sterry Hunt, Limits of the Cambrian Formation. 2. De Moeller, Composition et subdivisions générales du système carbonifère. 3. J. P. Lesley, Limits of the Permian and Carboniferous in Pennsylvania, 4. Vélain, Phénomènes Geysériens dans le Trias de Morvan à propos de la délimitation du Trias et du Lias.

The following papers were read on the 2d of September: 1. Cope, Relations of horizons of Vertebrate Fossils of Europe and North America. 2. Gosselet, De la Synonomie des especes fossiles au point de vue du droit de priorité. 3. Rouault, Amorphozoaires

du Silurien inferieure de Bretagne. 4. DeMorillet, Divisions du Quaternaire. 5. Winkler, Origine des dunes sur le littoral de la Hollande. 6. Van den Broeck, Influence des phénomènes météoriques sur l'altération des Róches. 7. W. P. Blake, Geological Maps of the United States of North America. 8. Violet d'Aoust, Origine des volcans. 9. Bouejot (by M. Delesse), Calcaire blue eruptif. 10. Choffat, Mélanges d'horizons stratigraphiques par suite des mouvements du sol.

Papers of the 3d of September: 1. Des Cloizeaux, Microcline et Feldspaths tricliniques. 2. Michel Lévy, Emploi du Microscope polarisant à lumière parallèle pour l'étude des roches. 3. Jannetaz, Rapports de la propagation de la chaleur dans les roches et de leur structure, au point de vue de leur origine. 4. Vélain, Ses Roches trachytiques de la Réunion au point de vue de la classification. 5. Sterry Hunt, Terrains Precambriens de l'Amerique du Nord. 6. Szabo, Classification et chronologie des roches éruptives tertiaires de la Hongrie. 7. Ribeiro, Formation Tertiaire du Portugal. 8. Chamberlin, The Kettle Moraine of the Great Lake district of North America.

On September the fourth, the Council presented to the Congress several propositions, viz:

A committee to propose a system of coloration for geological maps.

A committee to propose a uniform nomenclature for geological horizons and formations.

A committee to investigate and report on a method of uniformity in nomenclature in palæontology.

That the second meeting of the Congress take place three years hence in Bologna, Italy.

That in the *interim* the present Council of the Congress transact its affairs.

Which propositions were, with slight modifications of their original forms, adopted by the Congress.

The sessions of the Congress were largely attended, and under the able ruling of Professor Hèbert, were conducted with dispatch and effect. The interest of the occasion was enhanced by the entertainments offered by the Department of Public Instruction and by private citizens. Of the former may be mentioned that at the Arts et Metiers, where the garden was illuminated by the Jablokoff lights, and the one at the residence of the Minister. Of the latter, the entertainments at the residences of Profs. Hèbert, Gaudry and Daubrée, will be remembered by those who attended them. After the adjournment of the Congress a banquet was held at the Hotel Continental.

A number of the members of the Congress remained to take part in the annual excursions of the Geological Society of France, which immediately followed.

— In his recent lecture on civilization and science, Prof. Du

Bois-Reymond asks that more science be taught in the German gymnasia, though he does not propose to convert the gymnasium into a school for science-teaching. "All that I ask is that as much shall shall be done to meet the wants of the future physician, architect or military officer as those of the future judge, or preacher, or teacher of classical languages. Thus I ask for only so much natural history in the lower classes of the school as will awaken the faculty of observing, and that facilities be given for familiarizing the lads with the methods of classification which is rooted in the depths of the understanding, and whose educational force is so eloquently described by Cuvier. Let Darwinism, of which I am myself an adherent, be excluded from the gymnasium. In the higher classes, for the reasons assigned in my report, I should like to have taught, not physics and chemistry with experiments, but mechanics, the elements of astronomy, also of mathematical and physical geography—to which studies one hour more than heretofore could be devoted without injury."

— In Von Ihering's recent work on the nervous system of molluscs, a new arrangement of the molluscs is given which may be novel to our malacologists, as the work itself is rather expensive. The genus Chiton and allies are associated with the worm Chætoderma and the doubtful form Neomenia, forming the Phylum *Amphineura*, as follows:

VERMES.

Phylum *Amphineura*.

Class 1. *Aplacophora* (Chætoderma, Neomenia).
" 2. *Placophora* (Chitonidæ).

The mollusca are thus arranged:

MOLLUSCA.

Phylum I. *Acephala* (Lamellibranchiata).
" II. *Solenoconchæ* (Scaphopoda).
" III. *Arthrocochlides* (Gastropoda, Prosobranchiata).
" IV. *Platycochlides* (Class 1. Ichnopoda, embracing the Nudibranchiata, Tectibranchiata and Pulmonata.)
" 2. Pteropoda.
" 3. Cephalopoda.

— A work on the songs of birds and other animals as related to human music, and as furnishing a basis for a theory of melody, is in course of preparation by Mr. Xenos Clarke, of San Francisco, Cal., who writes that "the chief impediment is the lack of recorded observations. I should be most grateful if you could kindly assist me in any of these ways, viz:

"1. References to books, etc., containing songs of birds or other animals in musical notation. (Copies of these would be still more valuable.)

"2. Results of your observations on birds or their songs.

"3. Is there noticed with any frequency in these songs the occurrence of any fundamental intervals of human music, as the octave, fifth, fourth and third?

"4. (A question only seemingly irrelevant.) If singing in the ears has ever happened to you, have any of the fundamental intervals, above mentioned, been observed between the minute tones?

"5. Any information that may occur to you as bearing on these subjects?" We refer the matter to our ornithological readers.

— The *Zoologischer Anzeiger*, published in Leipzig and edited by Prof. J. Victor Carus, proves to be a most useful periodical. The editor has two objects in view: besides giving digests of new works and articles, to make the literature complete as possible and to have the addresses of working and teaching zoölogists, zoötomists, anatomists and palæontologists, as full and trustworthy as may be. For this purpose he would like to receive the aid of American naturalists, and especially to receive copies of our journals and proceedings in exchange for his journal. The *Anzeiger* will, by and by, contain a list of public museums, institutes, etc., which are not connected with universities and colleges. As the journal is published fortnightly, men of science will find it the most convenient way of publishing quickly short preliminary abstracts of new researches of all kinds relating to zoölogy.

— The New York Academy of Sciences begins its sessions for the winter in its new rooms, handsomer and more attractive than its previous quarters. The library of the Academy has been moved up town into rooms granted for it, in the new (fire-proof) building of the American Museum of Natural History, where it is to have the best care and accommodations and remains subject to the control of the Academy.

— The eleventh annual meeting of the Kansas Academy of Science was held at Topeka, on October 8th and 9th, with an attendance larger than in previous years. The number of papers presented was also larger than usual. Prof. B. F. Mudge, of Manhattan, was elected president, and E. A. Popenoe, of Topeko, secretary, for the ensuing term of one year.

— Recent arrivals at the Philadelphia Zoölogical Garden: 1 water snake (*Tropidonotus sipedon*), New Jersey; 2 capybaras (*Hydrochœrus capybara*); 1 douroucouli (*Nyctipithecus trivirgatus*); 1 capucin (*Cebus apella*), South America; 2 bonnet macaques (*Macacus radiatus*); 2 rhesus monkeys (*Macacus erythræus*); 1 common macaque (*Macacus cynomolgus*), India; 5 Guinea baboons (*Cynocephalus sphinx*), West Africa; 1 large alligator (*Alligator mississippiensis*), Florida; 1 European glass snake (*Pseudopus pallasii*), Austria; 5 copperheads (*Ancistrodon contortrix*), Pennsylvania; 1 green bittern (*Ardea virescens*); 1 golden-crowned thrush (*Seiurus aurocapillus*) Pennsylvania; 2 cinereous vultures (*Vultur cinereus*); 2 griffon vultures (*Gyps fulvus*), North Africa; 4 barn owls (*Strix flammea americana*); 2 Angora rabbits; 7 weeper capucins (*Cebus capucinus*), South America; 1 little brown bat (*Vespertilio subulatus*), New Jersey; 1 brown pelican (*Pelecanus*

fuscus), Florida; 1 rufous rat kangaroo (*Hypsiprymus rufescens*), born in the garden; 1 pig-tailed macaque (*Macacus nemestrinus*); 1 rhesus monkey (*Macacus erythræus*), India; 6 hog-nosed snakes (*Heterodon platyrhinus*); 1 garter snake (*Eutænia sirtalis parietalis*), Ohio; 1 opossum (*Didelphys virginiana*); 2 gray lizards (*Sceloporus undulatus*), New Jersey; 1 black snake (*Bascanion constrictor*); 1 water snake (*Tropidonotus rhombifer*), Illinois; 1 brindled gnu (*Catoblepas gorgon*), South Africa; 1 common quail (*Ortyx virginianus*); 2 whooping cranes (*Grus americanus*); 2 sandhill cranes (*Grus canadensis*), North America; 2 red coatis (*Nasua nasica rufa*), South America; 1 elk (*Cervus canadensis*), born in the garden; 2 tortoises (*Testudo tabulata*), South America; 1 gray squirrel (*Sciurus carolinensis*); 2 common hoopoes (*Upupa epops*), Europe, Asia and North Africa; 1 jackdaw (*Corvus monedula*), Europe and Asia; 1 sickle-billed curlew (*Numenius longirostris*), Atlantic States; 1 night hawk (*Chordeiles virginianus*), United States; 4 common chameleons (*Chamæleo vulgaris*), Europe, Asia and North Africa; 1 Yarrell's curassow (*Crax carunculata*), Brazil; 1 screech owl (*Scops asio*); 1 cat-bird (*Mimus carolinensis*); 1 green linnet (*Ligurinus chloris*); 1 chaffinch (*Fringilla cælebs*), Great Britain; 2 white-footed mice (*Hesperomys leucopus*), United States; 1 Savannah deer (*Cervus savannarum*), born in the garden.—*Arthur E. Brown, Gard. Supt.*

— American Naturalist. The numbers of this journal issued during the past year were published at the following dates: February, January 31st; March, February 23d; April, March, 19th; May, April 22d; June, May 22d; July, June 28th; August, July 27th; September, August 21st; October, September 23d; November, October 30th; December, November 29th. —*Editors.*

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

National Academy of Sciences.—The semi-annual meeting was held at New York, November 5–7. A report to Congress, recommending the future consolidation of the various geodetic, geographical and geological surveys of the United States, was adopted by the Academy. The following papers on natural science were read and discussed: The early types of insects, by S. H. Scudder; On the arrangement of the exhibition rooms in the Museum of Comparative Zoölogy at Cambridge; Arrangement of a zoölogical marine laboratory at Newport; On the embryology of the gar pike; On some of the zoölogical results of the United States Coast Survey Steamer *Blake*, by Alexander Agassiz; On some remains of new Dipnoan fishes and their relation to living forms; On some mooted points in American geology, by J. S. Newberry; On the characters of Theromorphous reptiles, by E. D. Cope; Note on the Two-ocean Pass, Wyoming Territory; On the discovery of recent glaciers in the Wind River mountains; Plan of a general geolog-

ical map of the Territories of the United States, west of the 94th meridian, by F. V. Hayden; Some remarks on an investigation of the laws of heredity, undertaken by the Board of Health of Massachusetts, by A. Hyatt; On the physical structure and hypsometry of the western Catskills, with some remarks on the whole group, by A. Guyot.

NEW YORK ACADEMY OF SCIENCES—October 14. Prof. A. A. Julien read a paper on "Chemical erosion on mountain summits," in which he presented a large number of facts, drawn from personal observation among the mountains of North Carolina, and the Catskills and the Shawaugunks of New York, indicating the existence of a powerful agency of chemical erosion in connection with vegetable acids. He recalled the recently published articles of Prof. H. C. Bolton, read before the Academy, on the action of organic acids upon minerals, and their use as tests and reagents in mineralogy, and then presented his own observations, as tending to show that like processes are going on in nature on a great scale, particularly through the action of lunnic, intro-lunnic and ulmic acids upon silica. He described in detail the remarkable erosion of the Shawaugunk Grit, along the precipitous edge of the mountains of that name, in situations and ways which indicate that it can be only due to decomposing vegetation. The paper was discussed at length, and generally regarded as possessing great significance.

November 4. Prof. W. P. Trowbridge made a communication regarding disputed questions in animal locomotion.

AMERICAN GEOGRAPHICAL SOCIETY.—November 12. Rear Admiral Daniel Ammen, U. S. N., read a paper upon the proposed inter-ocean ship canal across the American Isthmus, between Greytown and Brits, via Lake Nicaragua; its feasibility as a commercial question, and its advantages as compared with other proposed routes.

BOSTON SOCIETY OF NATURAL HISTORY.—October 16. Prof. N. S. Shaler remarked on certain peculiarities in the structure of the swamp cypress (*Taxodium distichum*).

November 6. Mr. M. P. Kennard described the recently discovered glacial relics at Lucerne, Switzerland.

APPALACHIAN MOUNTAIN CLUB.—November 13. Prof. E. T. Quimby read a paper on Sun telegraphing, and Prof. E. C. Pickering remarked on a proposed system of mountain signalling.

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SCIENTIFIC SERIALS.[1]

THE GEOGRAPHICAL MAGAZINE.—November. The Afghan passes (with a map of the Kaibar, Karkatcha and Kurram passes), by Trelawny Saunders. The Kuldja Question. Explorations in Greenland, by R. Brown. M. Ujfalvy's Travels in Central Asia.

THE GEOLOGICAL MAGAZINE.—November. The general history of the Cephalopoda, recent and fossil, by Miss A. Crane.

[1] The articles enumerated under this head are usually selected.

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